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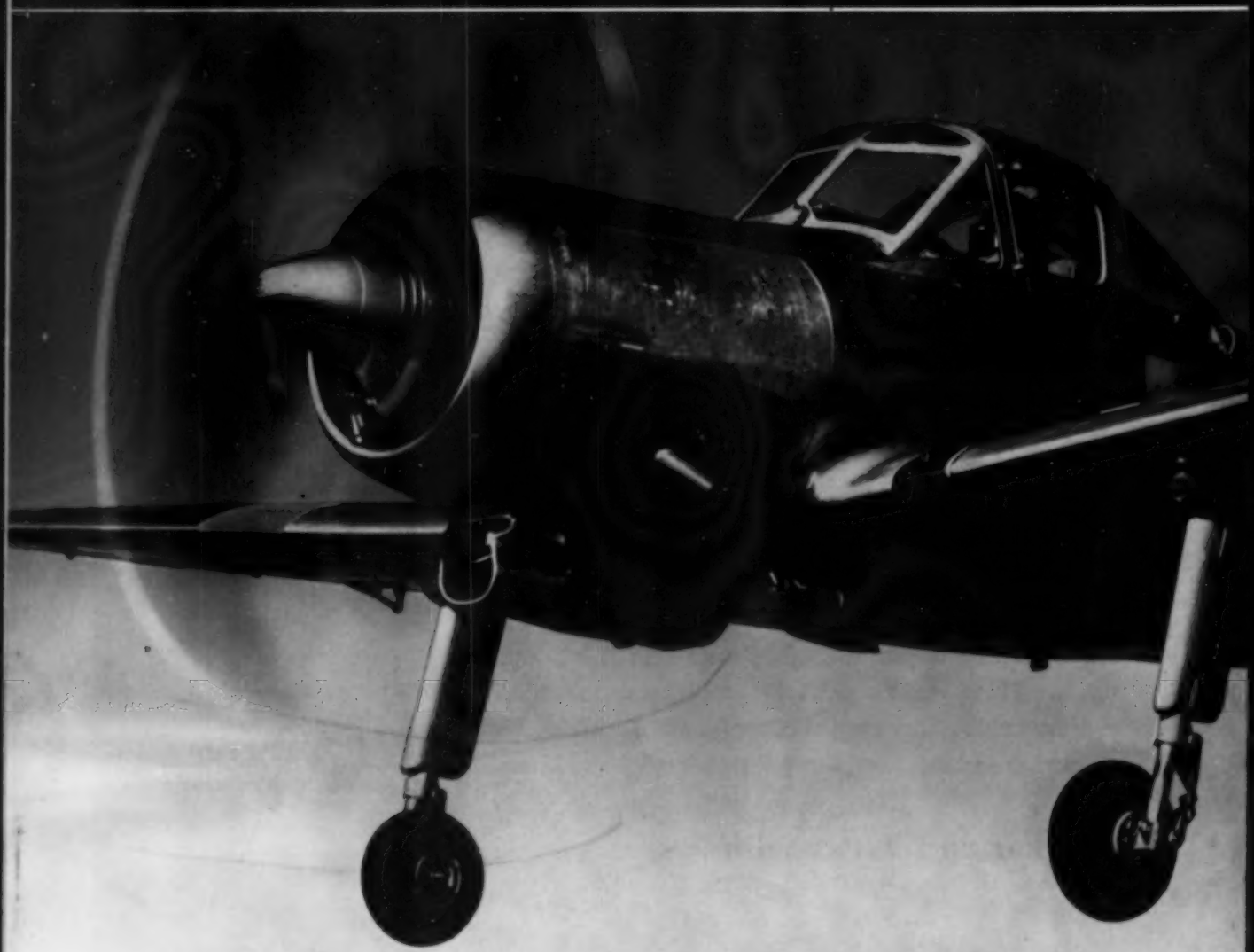

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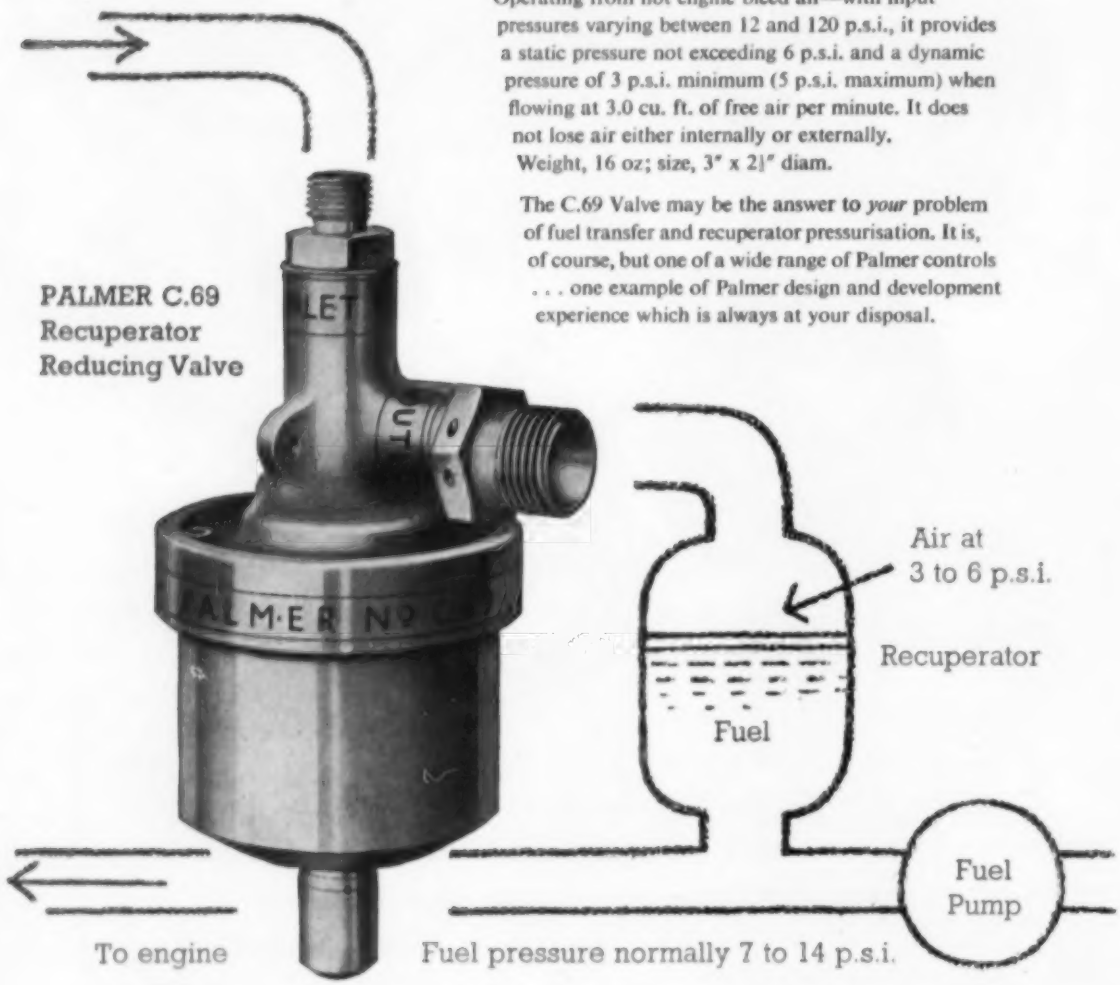

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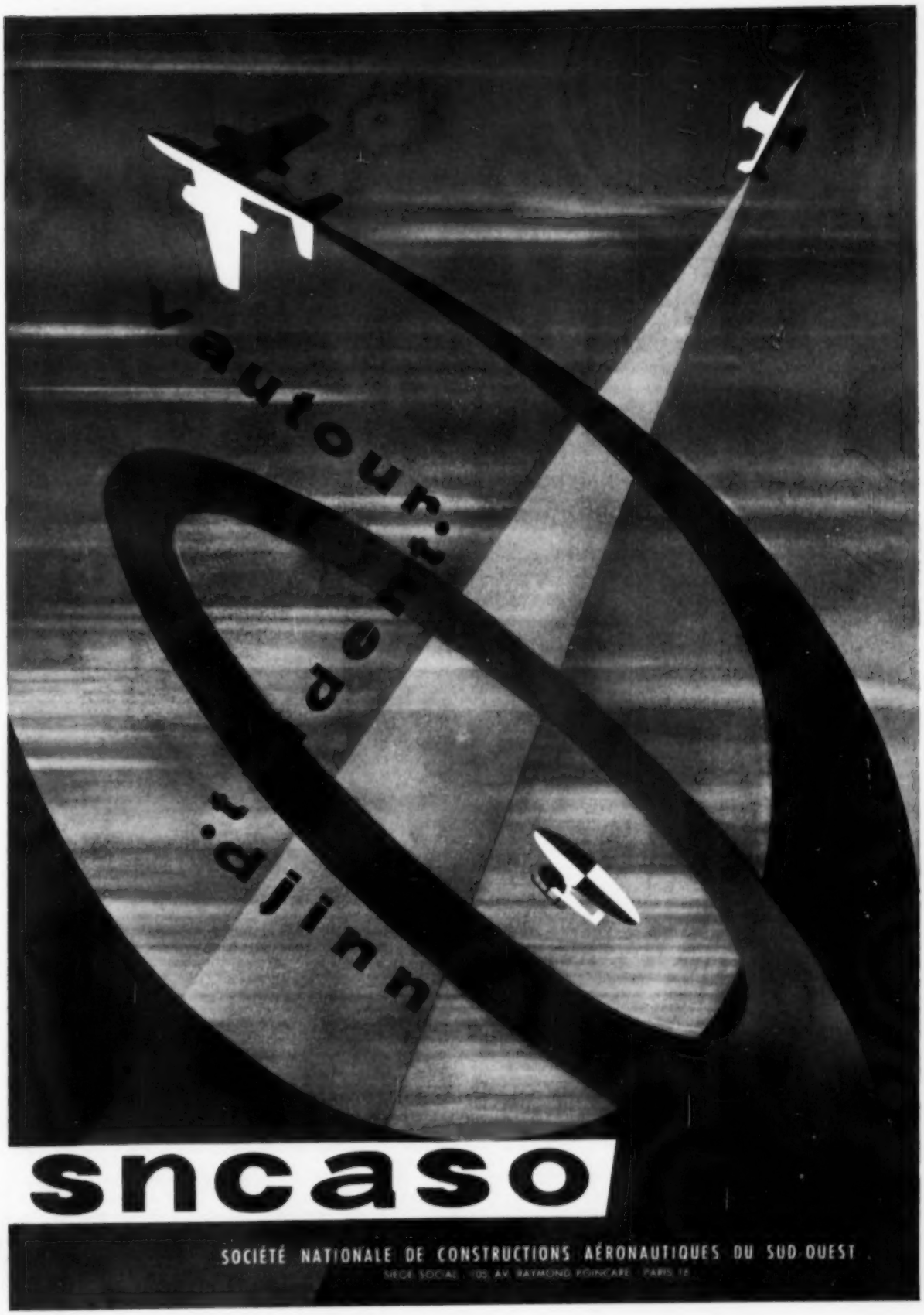
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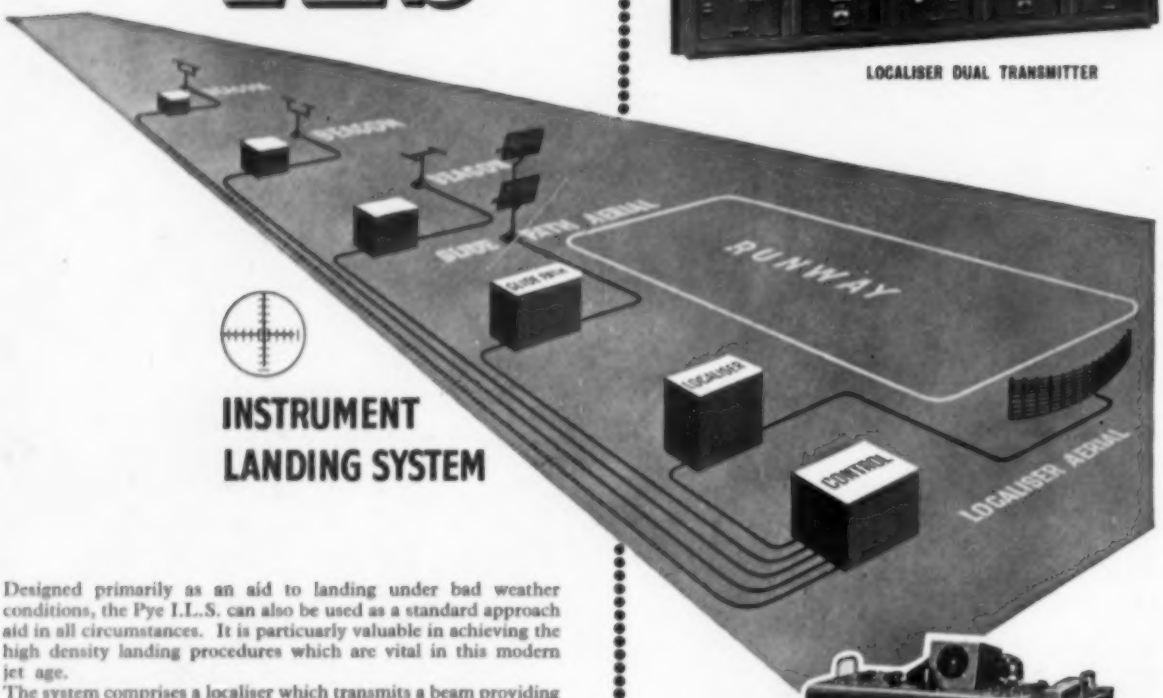

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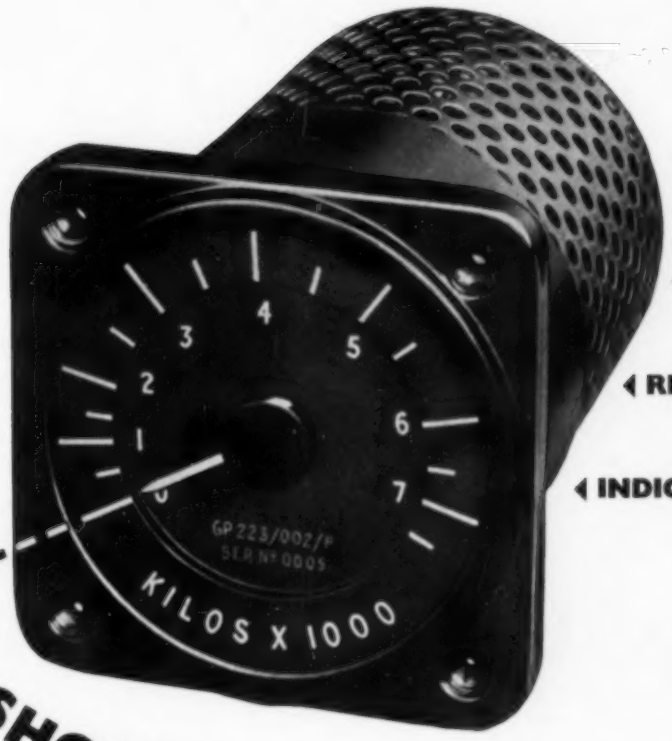

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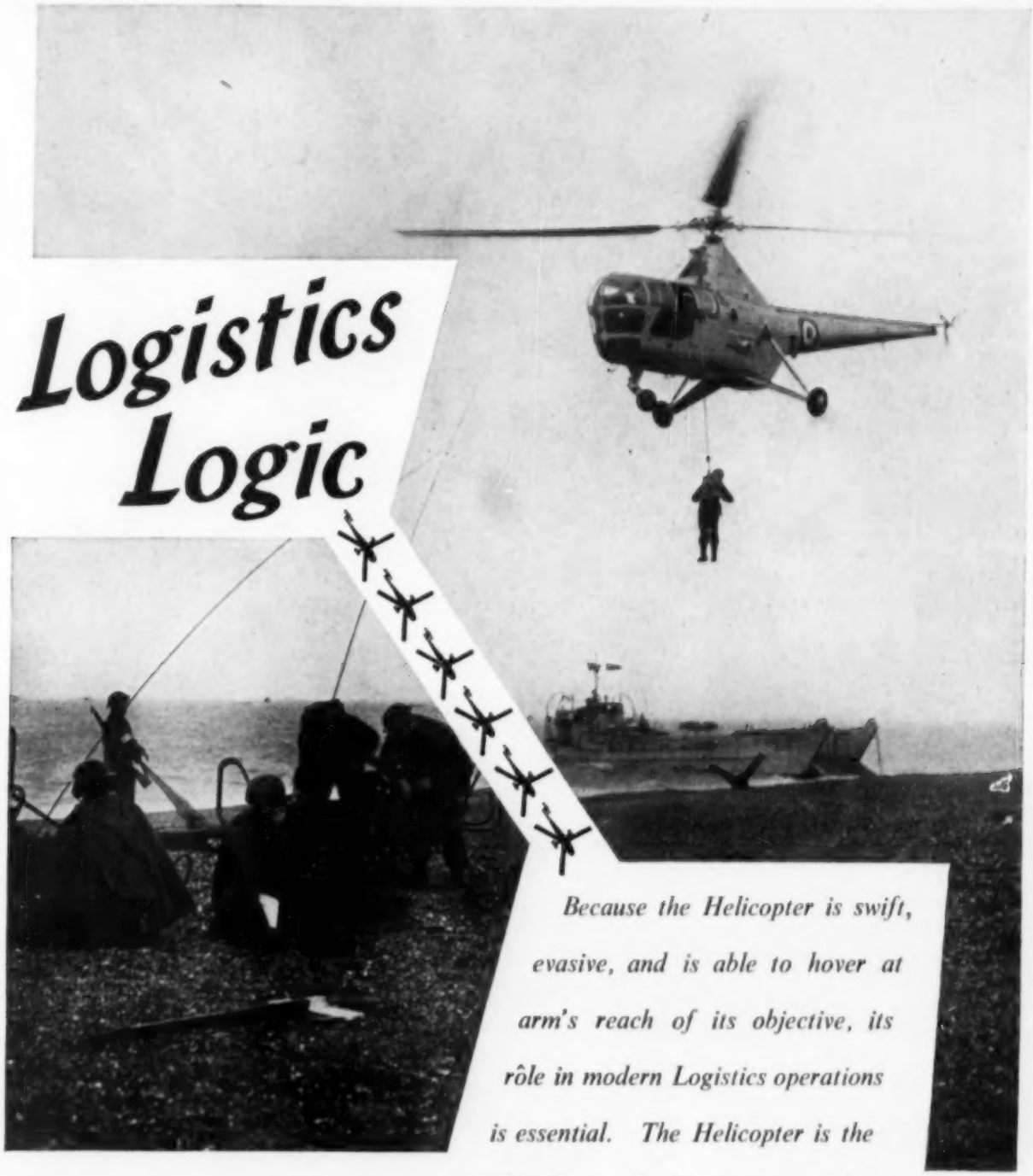

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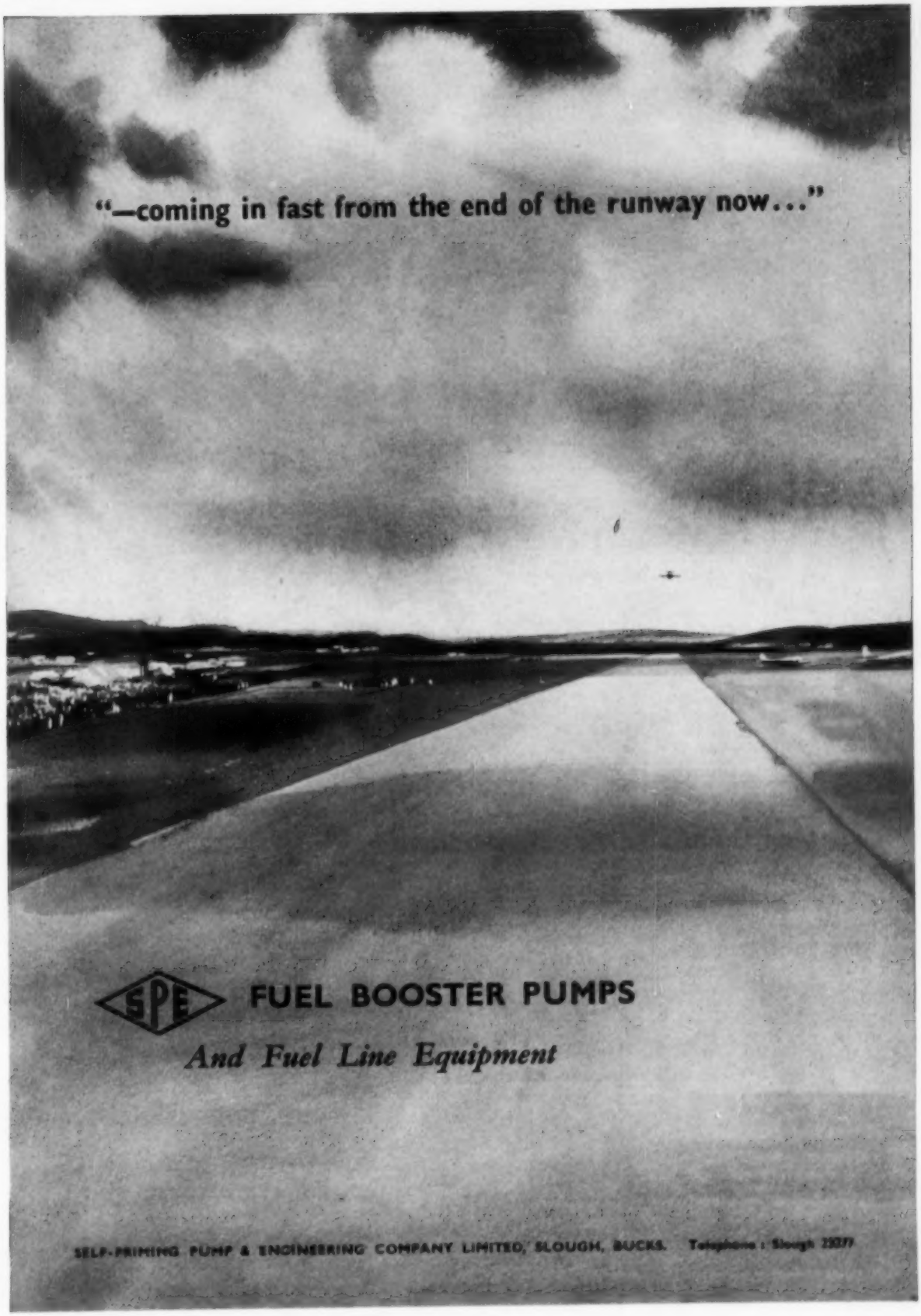
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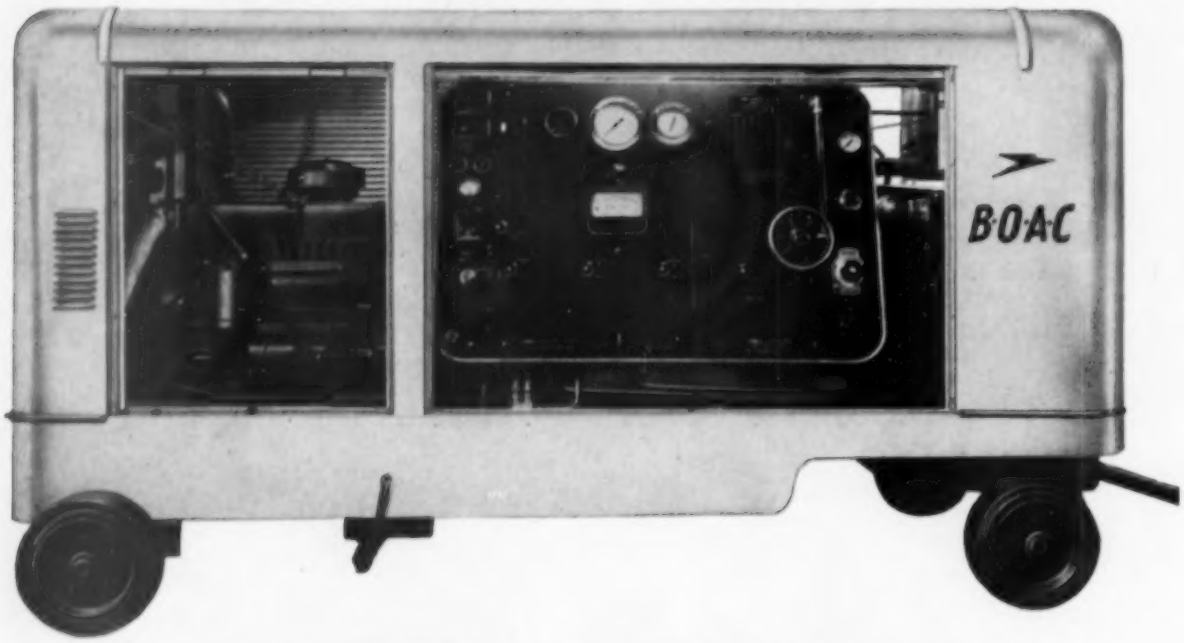

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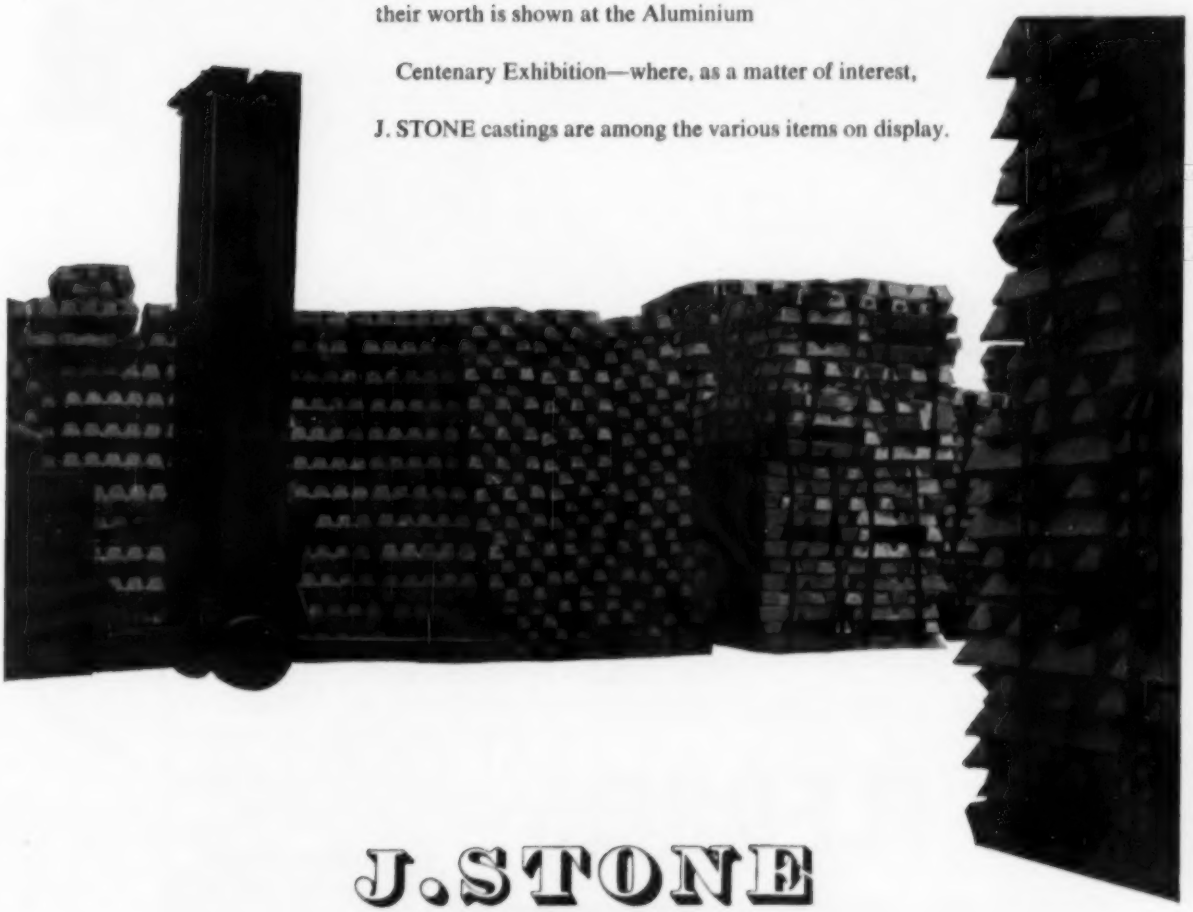

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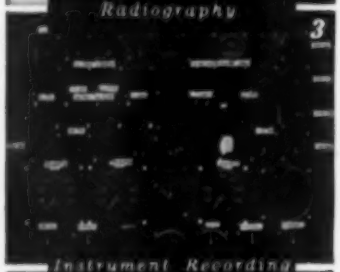

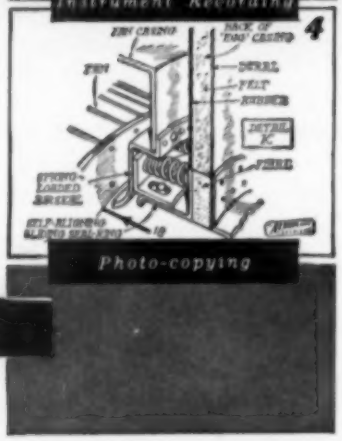

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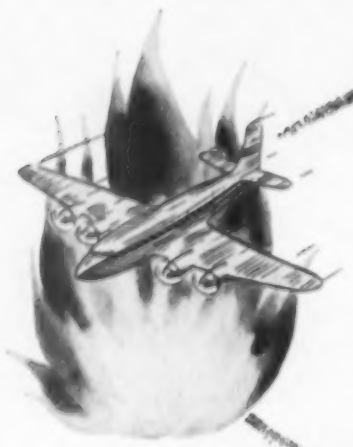

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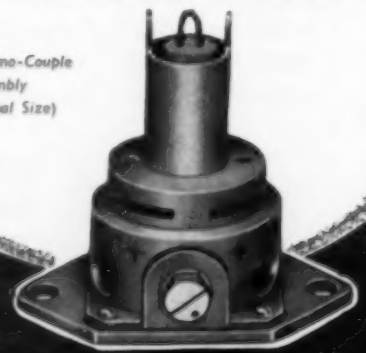

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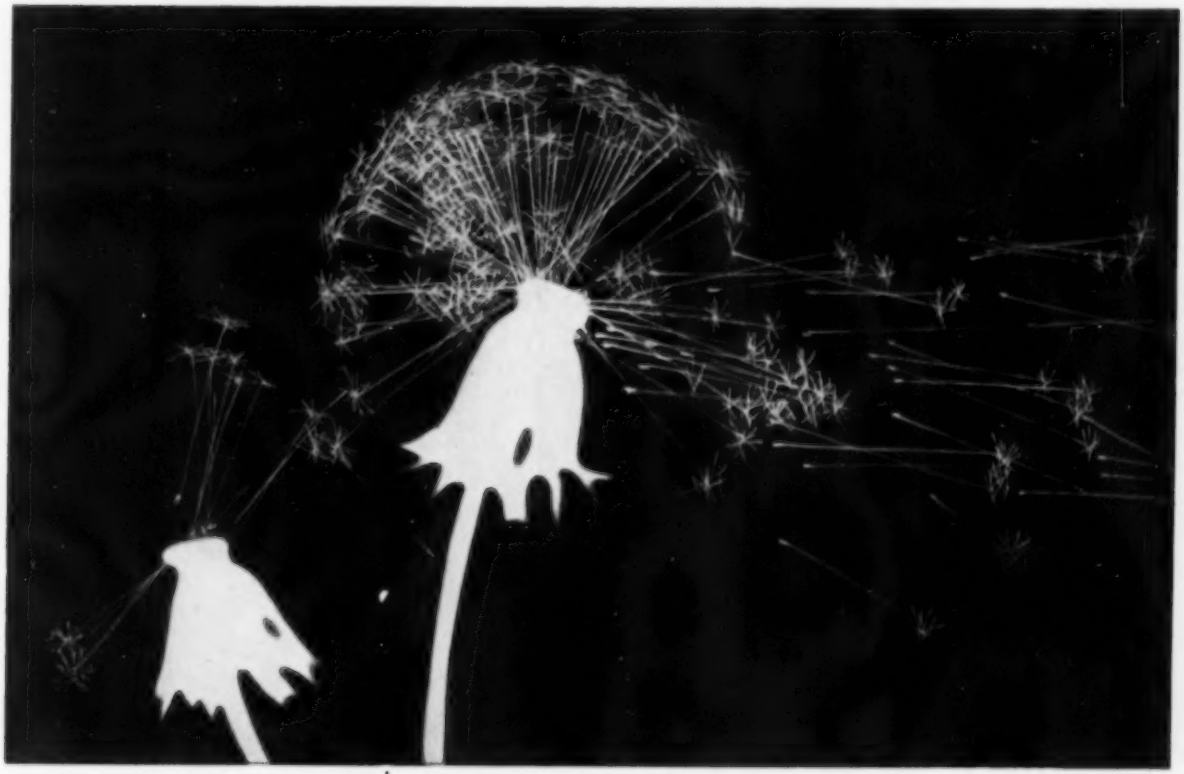

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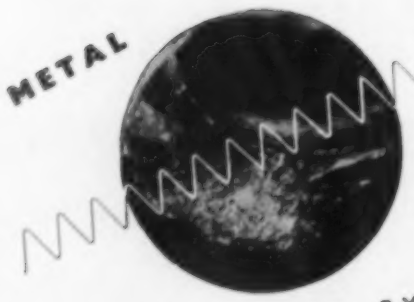

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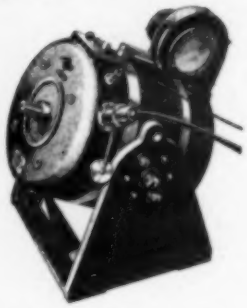

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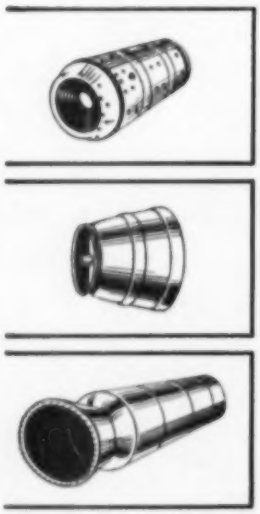

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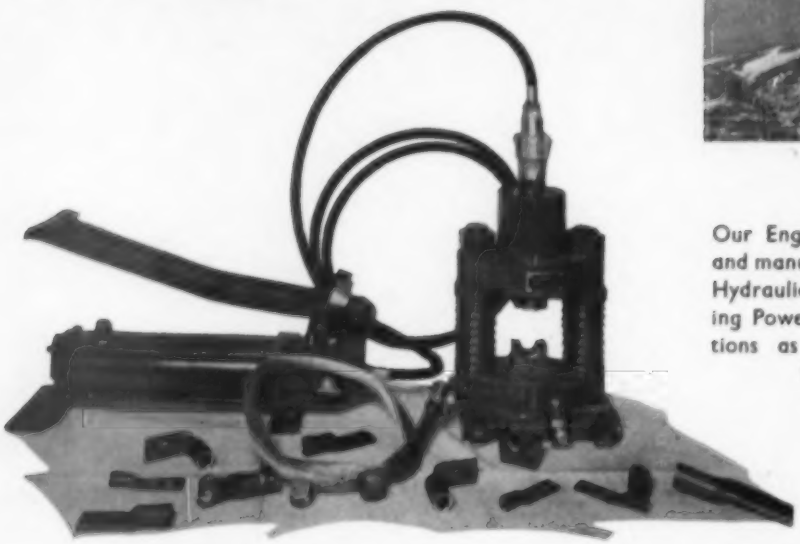

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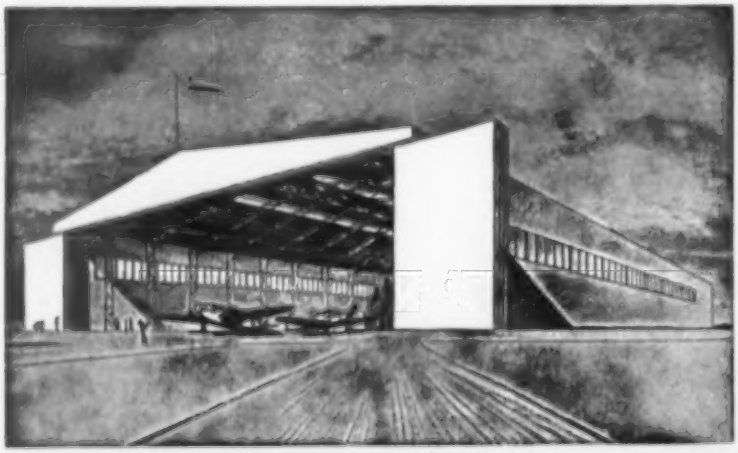

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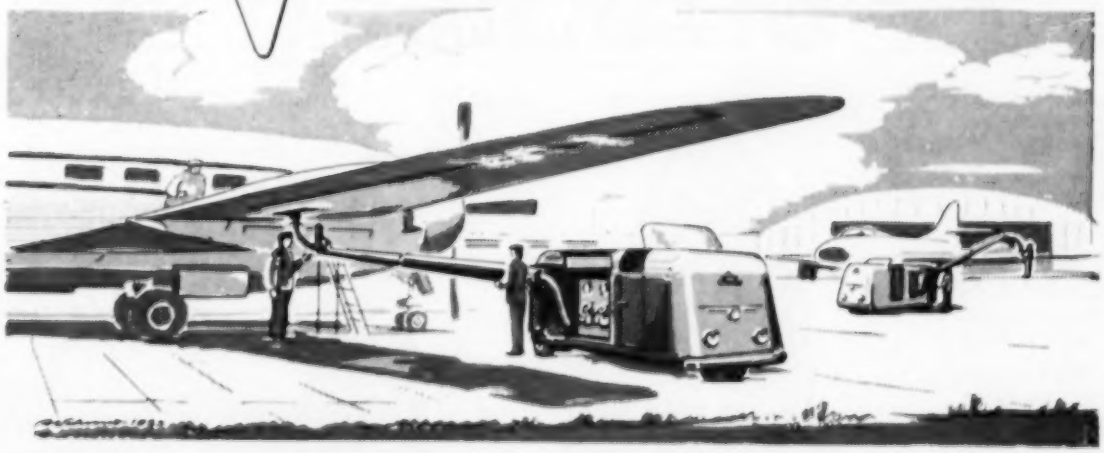

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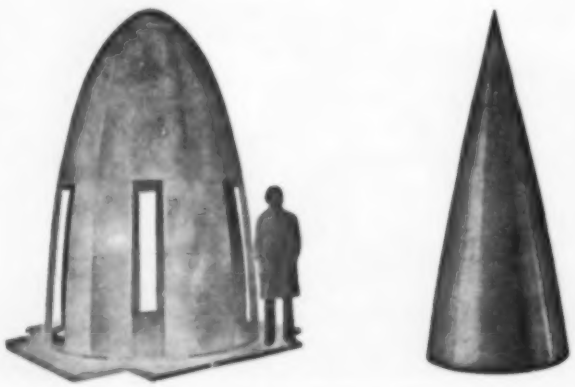

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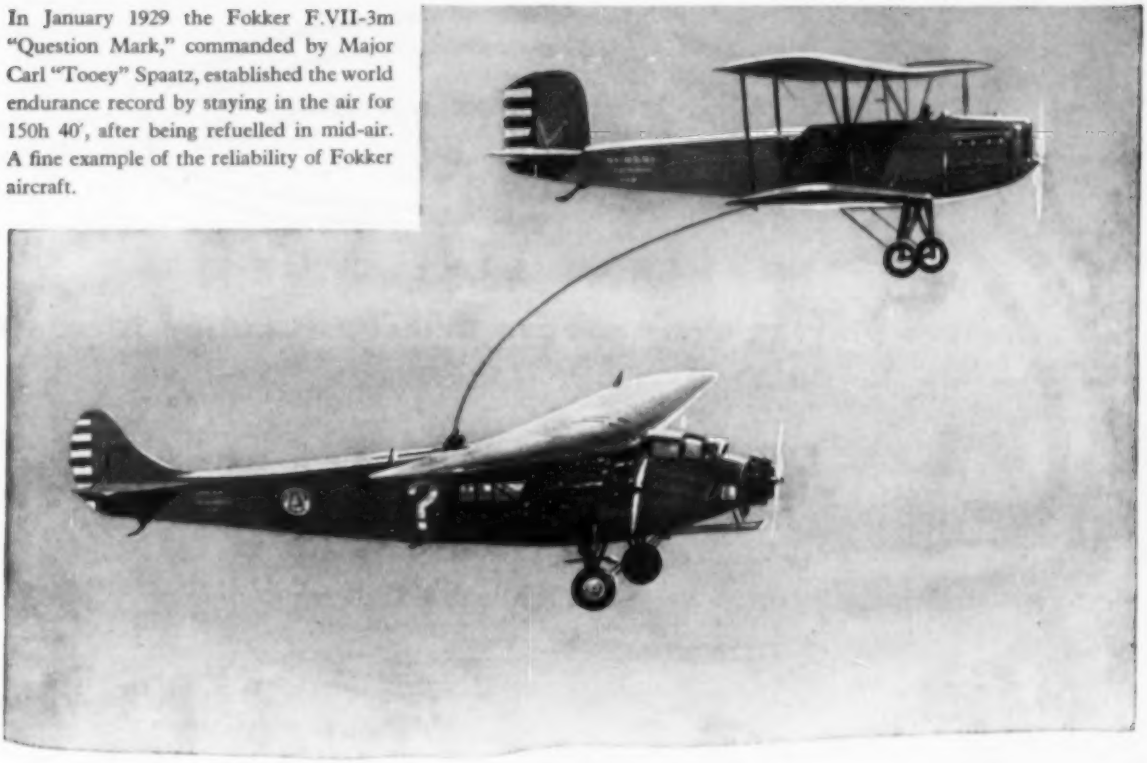

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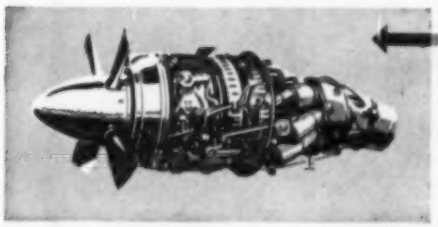

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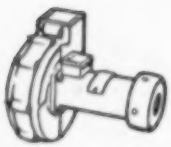

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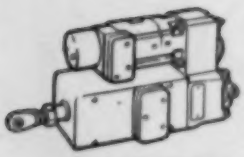

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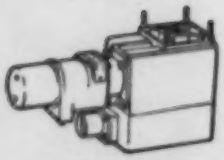

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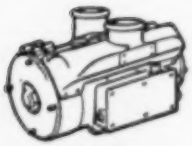

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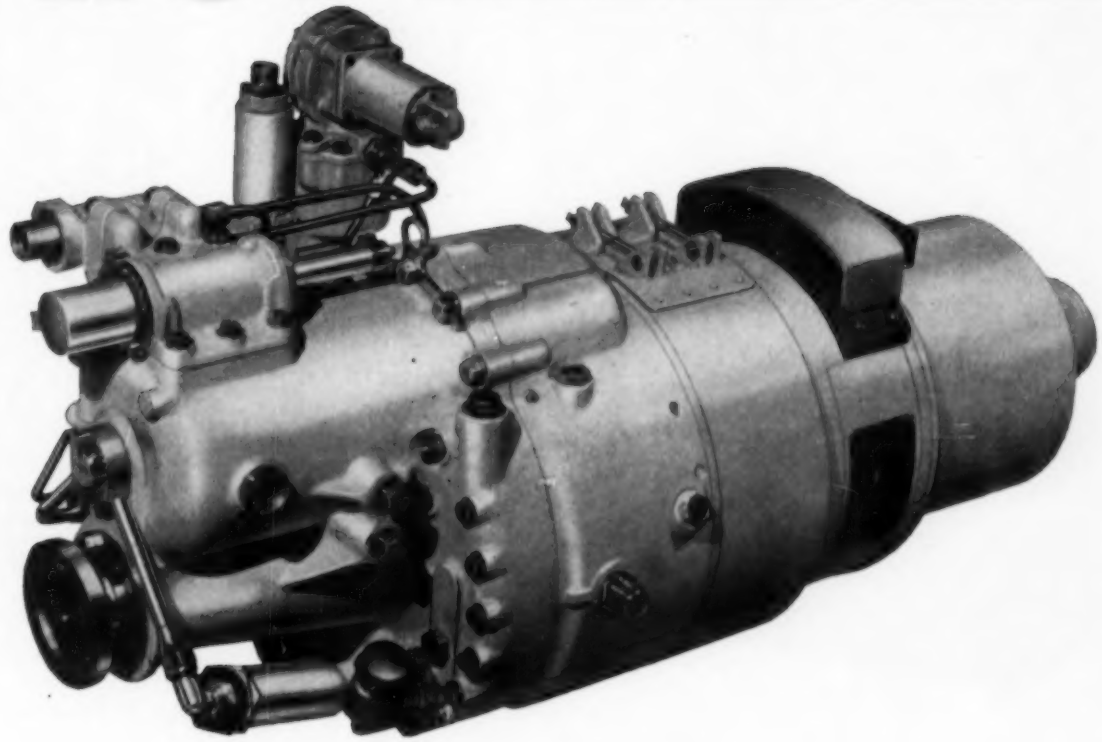

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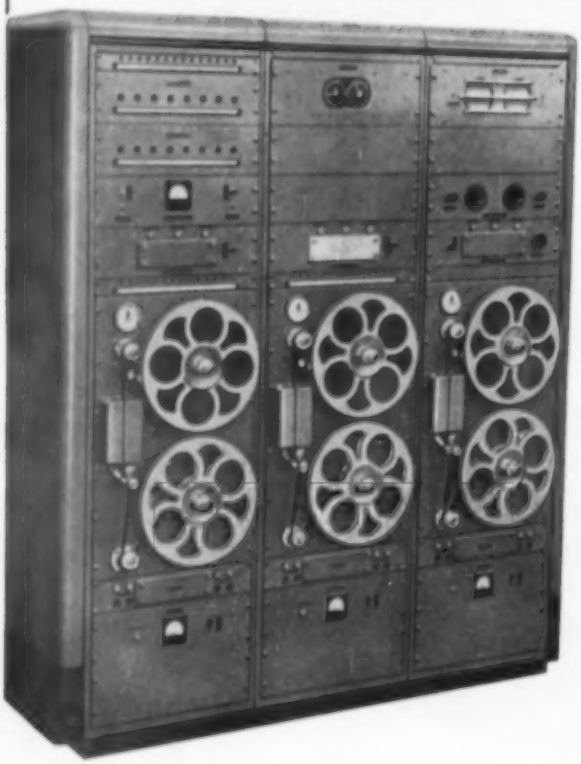

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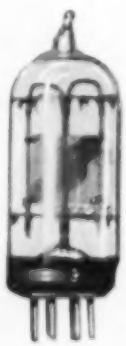

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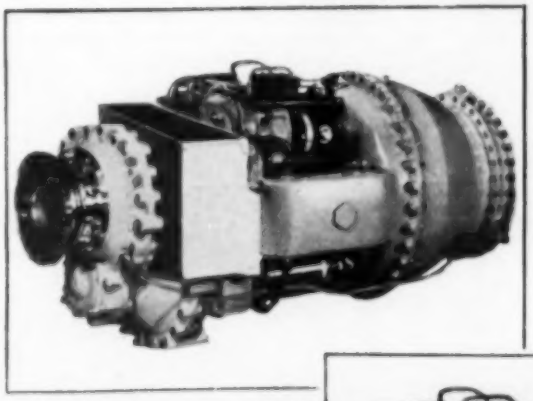

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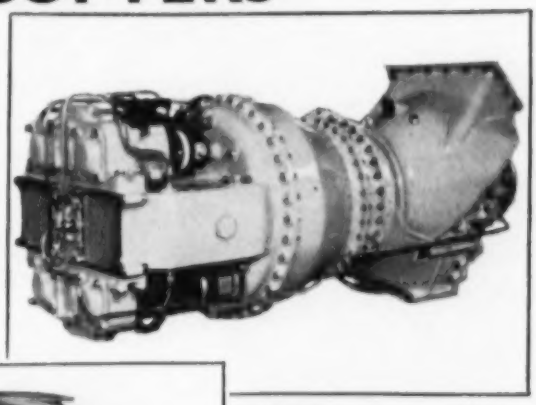

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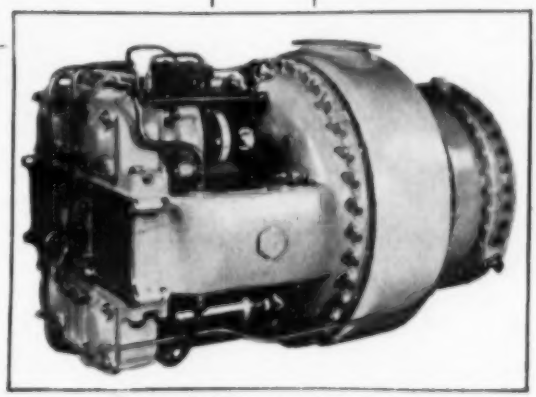

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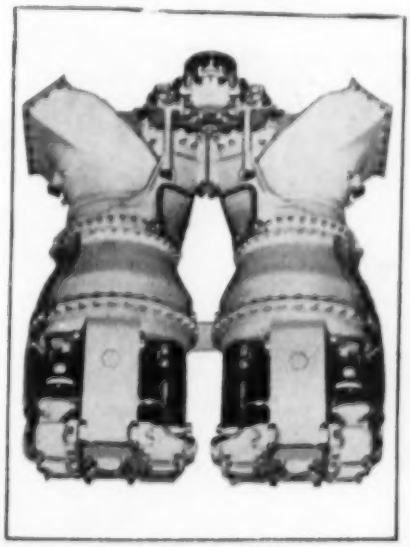

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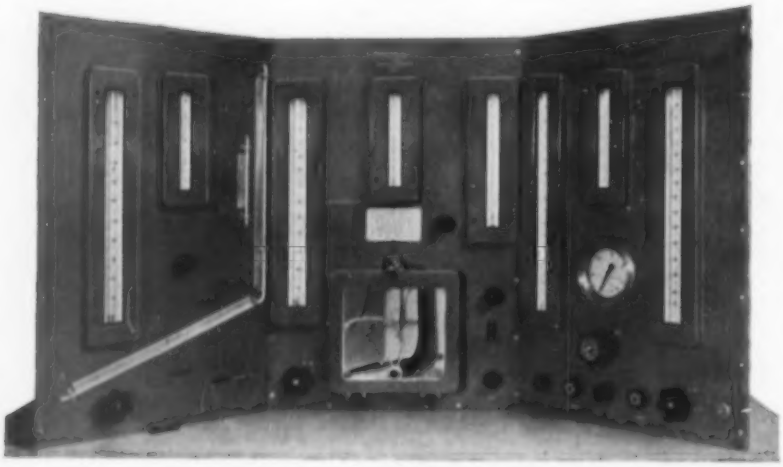

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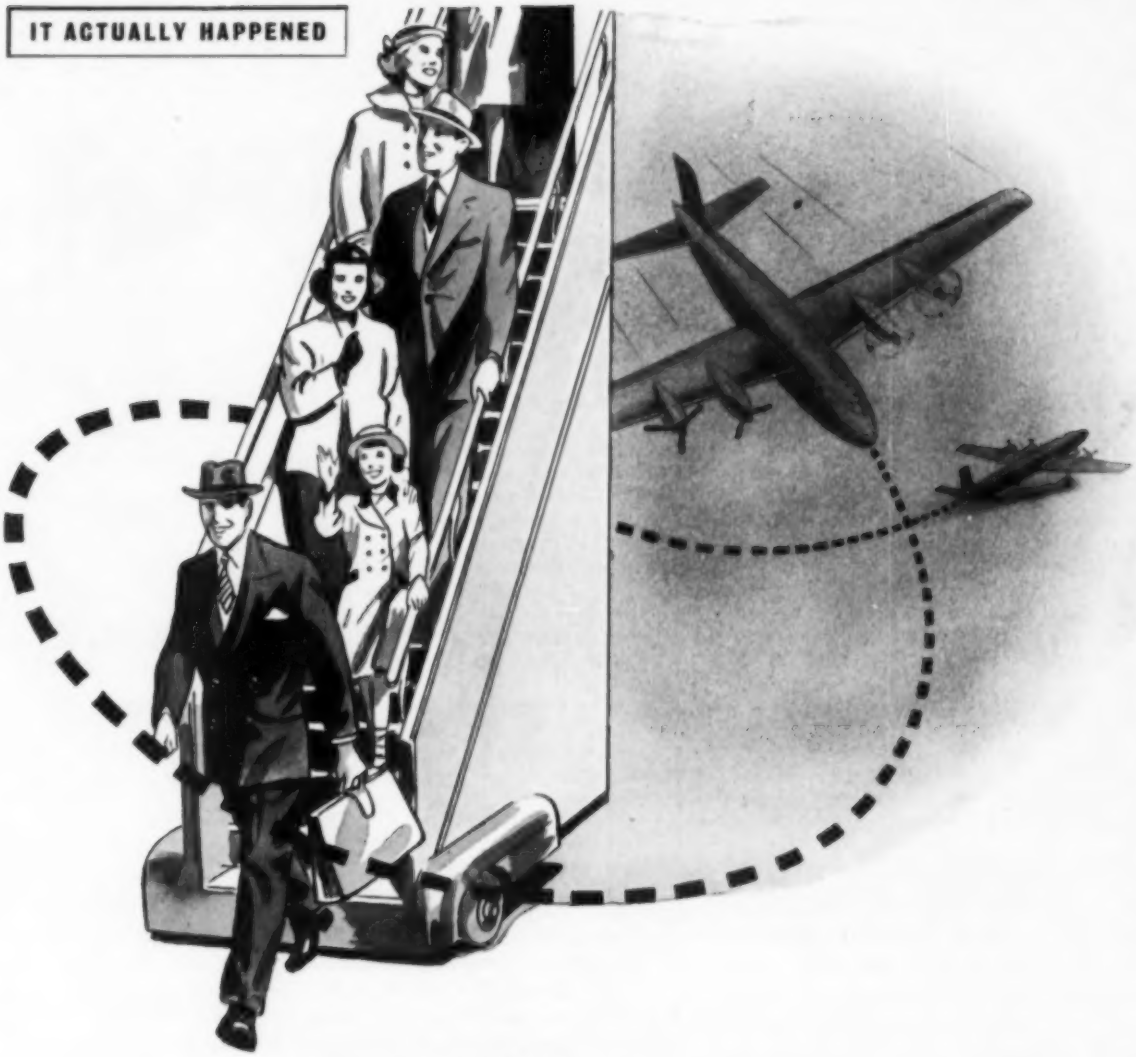
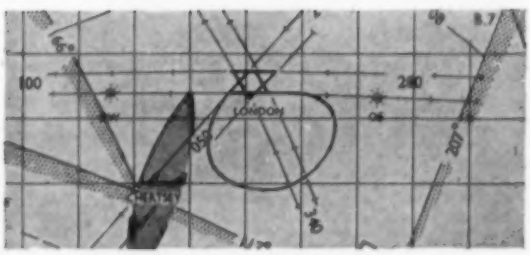


ALL'S WELL...

A few seconds after taking off into thick haze both starboard engines cut. The loss of this power combined with a strong cross wind, prevented the pilot from using either I.L.S. or G.C.A. on the instrument runway. By using the FLIGHT LOG the pilot was able to land without delay on the runway into wind. Only Decca could help in this emergency. *At any moment, at any height, in any weather you know where you are with Decca.*



The track of the aircraft as shown on the Flight Log

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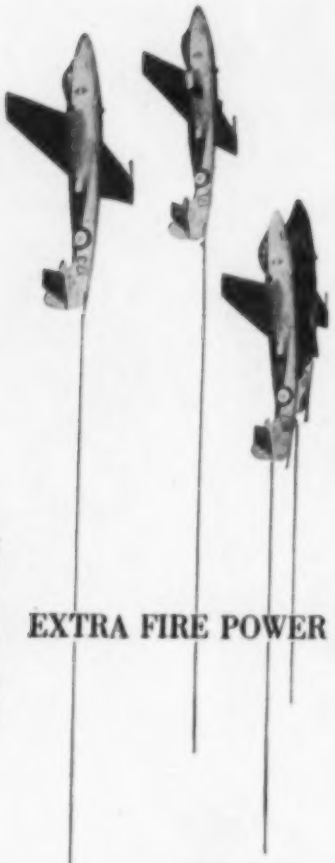

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Masterpieces in Metal

IN remarking, as we do elsewhere in this issue, that only through the discovery of aluminium were modern aircraft made possible, we may perhaps be guilty of false logic, for in such imponderable circumstances it would be equally arguable that if aluminium had *not* been made commercially available, other materials—including synthesized plastics—might have taken its place. Be that as it may, none will deny that this very remarkable material is worthy of the attention it has been receiving during the past ten days, notably at the "Aluminium 1955" exhibition in London.

The exhibition celebrates first production—not commercially, but in a laboratory—of the metal in Great Britain, in 1855. Sir Humphrey Davy had almost succeeded in isolating it nearly 50 years earlier, and in the interim a Dane and a German had come even nearer success. It was a Frenchman, Ste. Claire Deville, who first succeeded in producing a bar of the light, silvery metal; this was in 1854, and he showed it at the Paris Exhibition of 1855.

But many more years were to elapse before aluminium could be produced on a commercial scale, and it was not until well into the present century that methods were found of alloying the basic metal to increase its strength. Since then the story (some aspects of which are dealt with in the review of the British aluminium industry on pages 808-813 of this issue) has been one of continuous progress—progress accelerated by two world wars. Today there are aluminium alloys that are stronger than mild steel, yet scarcely more than one-third of its weight.

The demands of the aircraft industry, more than any other, have encouraged the evolution of such materials, in both basic and fabricated forms, by specialist suppliers whose science amounts to a fine art; and—aside from any question of physical properties—the forgings, castings and extrusions they produce do indeed have the visual perfection, the sure touch, of masterpieces.

Right Noble Joust

YEAR after year, on that most inspiring and inspiriting occasion the Royal Tournament, the R.A.F. and the Fleet Air Arm are hard-pressed in their pursuit of honour and glory by venturesome and spectacular formations of the Army; by the liveliest and hardiest of the Navy's salt-water elements; the near-mechanical precision of the Royal Marines; and—just to keep them well up on their toes—by crack contingents from overseas (this year from the Arab Legion and Pakistan Police). The distinction with which they acquit themselves gives cause for more than ordinary satisfaction, for to put across at Earls Court some operational, or at least aerial, aspect of R.A.F. work is always a most worrisome business. Yet with imagination and resource the Air Force invariably finds something to divert and edify the public.

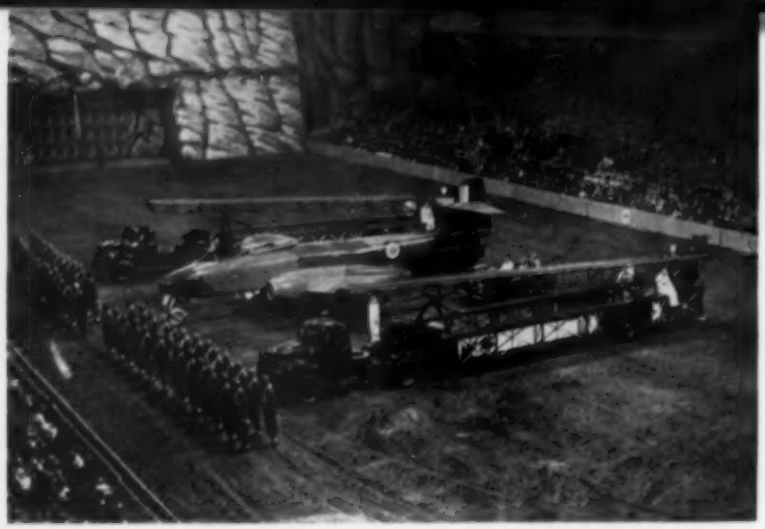
Their offering this year, though having as its theme "safety equipment" (none too gripping, this, having regard to the deeds of derring-do enacted by the other Arms) leaves no one in doubt that the Service is well equipped and qualified to look after itself. To achieve this end the products of Gloster and Martin-Baker have been enlisted; and with a great dashing of Land Rovers, banging of explosives, and tumbling of parachutists, the techniques of seat ejection and parachute-landing are simulated, with due measures both of enlightenment and entertainment. It could hardly have been done better, even with less constraint of space or expenditure.

In their maze-marching, too, the R.A.F. are on the beam all the way; and in a display by the combined Women's Services the W.R.A.F. are not least in grace or gumption. To ourselves, moreover, the R.A.F. massed bands seem the most musical of all, while they manœuvre with the perfection of the Coronation fly-past.

As for the Fleet Air Arm—in the Royal Naval Field Gun Competition, be it noted—we saw them leave their Devonport rivals dazed by their hurtling disregard for limb, if not for life, to thunder home with nearly two minutes in hand.

Truly, there must be something in the air. Doubtless next year we shall have an air marshal carrying off the Sword, Lance and Revolver prize.

FROM ALL QUARTERS



SMART TURN-OUT in more than one sense is the R.A.F. Royal Tournament presentation wherein, as mentioned in a leading article, the Martin Baker ejection seat figures largely. The general theme is "safety equipment" and the technique of parachute-landing is demonstrated.

Over the Top

THE first Commonwealth air service to follow the Arctic route between North America and Europe was inaugurated on Friday last, June 3rd, when a DC-6B of Canadian Pacific Airlines left Vancouver for Amsterdam *via* Sondre Stromfjord, Greenland. Reaching Schiphol on Saturday, its 36 guest passengers continued to London on Monday by B.E.A. Viscount.

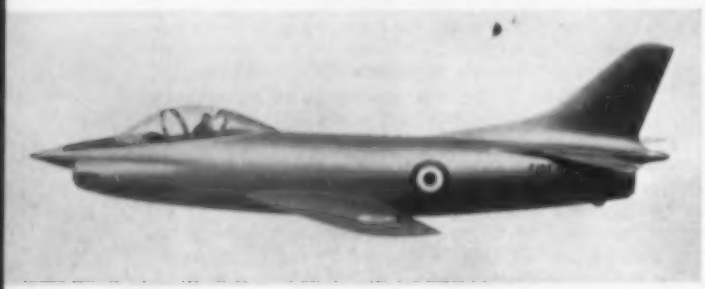
The new service, which operates weekly in each direction, forms an eastward extension of C.P.A.'s Pacific route to Sydney, and among the passengers were a number who set out from Australia by C.P.A. on June 1st and thus became—it is claimed—the first travellers to cross the international date line, the equator and the Arctic Circle in a single air journey. Passengers from Vancouver included Mr. G. W. G. McConachie, president of C.P.A., who has again expressed interest in the Comet 4 as a replacement for the DC-6B. Initially C.P.A. would want four aircraft for delivery in mid-1959 but might eventually buy a total of 12 Comet 4s.

Executive Viscounts

ALTHOUGH no official details of the executive versions of the Viscount have yet been released by Vickers-Armstrongs, Ltd., the American journal *Aviation Week* has published a description which seems to be broadly correct. The journal also states that Vickers have orders for more than six such machines, including the three officially announced as having been ordered by U.S. Steel.

It is stated that Vickers are offering potential customers a "bare hull," incorporating a Capital Airlines cockpit with Bendix autopilot and Collins radio, slipper tanks and Rolls-Royce Dart 510 engines. Such a configuration could be delivered in 26 months, and would cost, it is said, $924,000, plus 15 per cent import duty. (This figure would seem to include some schedule of spares.) The "bare hull" would be flown to the U.S.A. and the interior would then be furnished, duty-free, to the customer's specification.

If required, additional tankage could be provided in the belly, within the pressure hull, giving the following fuel capacities (U.S. gal): wing, 2,280; slippers, 348; and belly, 540. The ultimate still-air range, allowing climb to cruise at 25,000ft, is quoted as 2,875 statute miles (2,500 nautical), some 400 st m more than for standard 700Ds. With this tankage the maximum gross weight is 63,000 lb, and the disposable load 33,400 lb. It is averred that "more powerful versions of the Dart" will be capable of installation later, with only minor modifications. With series 510 engines the cruising speed is given as 320 m.p.h.



TURIN TRANSONICS: Fiat have now flown their first F-86K all-weather intercepter (left, below). Production is being helped by North American, but deliveries have been retarded by various industrial and political factors. The other aircraft is the forthcoming G.91, successful in the NATO light ground attack competition. Orpheus-powered, it strongly resembles the F-86K in layout.

Biggest Air Exercise

THE largest air exercise ever held is to take place in the Allied Air Forces Central Europe area from June 20th to 28th under the code-name Carte Blanche. More than 3,000 aircraft are to be involved, from most of the NATO nations, as well as aircraft from Bomber and Fighter Commands; the U.K.-based 49th Air Division, U.S.A.F.; and the Mediterranean-based U.S. 6th Fleet. French Air Defence Command is to be tested at the same time, and special arrangements have been made to minimize risks of collision with civil aircraft.

Beverley Tanker

IN co-operation with Blackburn and General Aircraft, Ltd., the Field Aviation Co., Ltd., of Oshawa, Canada (a member of the Hunting Group) have projected a specialized tanker version of the Beverley for the supply of Arctic outposts.

The Beverley would be able to bring in 6,000 gallons of fuel (or 160 people or 50,000 lb of cargo) on each flight, and would be able to work from rough, unpaved fields of 3,000ft length. The direct operating cost is given as seven cents per short-ton statute-mile, and the first cost as "just over one million dollars." There would be very few engineering departures from the basic Transport Command design, although the Canadian company state that minor changes would result from the use of "direct fuel injection" into the Bristol Centaurus engines, which would "boost the take-off power from 2,850 b.h.p. to 3,150 b.h.p. with similar increases in the ratings." These engines are described as Centaurus 373s.

Antarctic Survey Contract

AN air survey expedition to the Antarctic was announced by the Colonial Office last Tuesday. Its purpose is to produce accurate maps of the Grahamland peninsula, a Dependency of the Falkland Islands.

This is the first time an aerial expedition has been attempted on such a scale in the polar regions; it will utilize aerial photography and ground surveying, and a contract has been awarded to Hunting Aerosurveys, Ltd.

Two Canso amphibians, modified and equipped by the Photographic Survey Corporation of Toronto—a Hunting associate—will be used. One of them will be fitted with geophysical equipment enabling magnetometer and radioactivity surveys to be carried out when the weather is unsuitable for photography.

The company is to charter a ship to convey stores and ground personnel, and this will be adapted to allow a helicopter to operate off the deck. It is intended to obtain vertical air photographic cover of some 50,000 square miles of this remote and little-known territory. Leader of the expedition is Mr. P. G.

SHORT LINES LENGTHEN: On the left, at the Queen's Island works of Short Bros. and Harland, Ltd., are Seamew A.S.1 anti-submarine aircraft, and on the right, at the same works, are wings for the first of fifteen Bristol Britannias for which the company has contracted.

Mott (technical director of Hunting Aerosurveys), while the flying operations will be controlled by Mr. J. H. Saffery, D.S.O., the company's flying manager.

The ship is scheduled to leave London in late October, and the aircraft will leave Canada in November; the expedition will return in April next year.

A New Gipsy

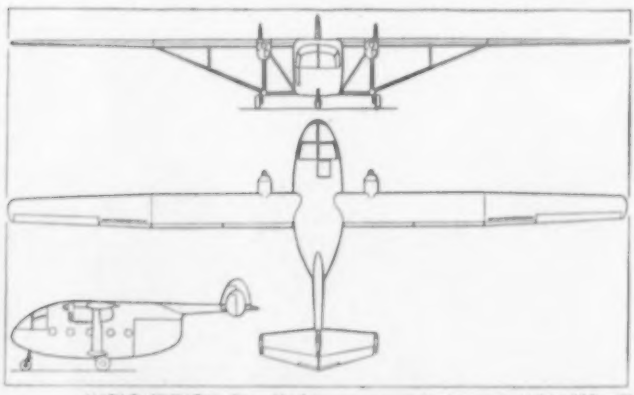
ILLUSTRATED on p. 791 is the de Havilland Gipsy Major 200, the latest in what is surely the longest line of four-cylinder, air-cooled aero engines in the world. Intended for both fixed- and rotary-wing aircraft, the Series 200 takes the Major's power into the 200 h.p. range, and incorporates advanced features which have been proved in service in the later Gipsy Queen engines.

The Major 200 is a normally aspirated engine, using the same design of cylinder as the Queen 70 Mk 2; thus the swept volume, at 6.8 litres, is 700 c.c. more than that of previous Majors. A major development is the employment of direct fuel injection into the inlet ports, which, by virtue of its high aerodynamic efficiency and "near-perfect" mixture distribution, combines with an increased compression ratio to give significantly better power and economy. Icing troubles are also eliminated. Provision is made on the rear wheel-case for a full range of accessories. A version of the Major 200 is also being prepared to run, at slightly lower power, on 80-octane M.T. spirit.

Development is already at a very advanced stage, and a considerable amount of running has been completed both on test beds and in the Saro Skeeter 6 helicopter.

Cross-Channel Co-operation

IT is now a year since F. G. Miles, Ltd., of Shoreham Airport, Sussex, became British and Commonwealth representatives for the Société des Avions Hurel-Dubois. The technical and commercial collaboration between the two firms has now been cemented by the signing of an agreement to form a joint company to be known as H-D and M. (Aviation), Ltd. In addition to acting as sole sales agents in the U.K. and Commonwealth (excluding Canada and India) for the H.D.32 and its derivatives, the new company will explore the application of Hurel-Dubois principles to existing aircraft and will generally exploit to the full the high-aspect-ratio formula.



ANGLO-FRENCH: Described in a paragraph above, the HDM.105 will permit of a direct comparison between high-aspect-ratio and "conventional" aircraft.

As already announced in *Flight*, the first project to be undertaken is the development of the HDM.105, basically a Miles Aerovan with a metal wing of Hurel-Dubois pattern. Apart from this wing, and the associated wide-track undercarriage, the HDM.105 will be a standard Aerovan with Cirrus Major III engines. The increase in performance, compared with the existing Aerovan, should be marked, as the following data show. Hurel-Dubois will show a wind-tunnel model of the HDM.105 at the Paris Salon. Miles are beginning to build an HDM.105 at Shoreham. The 75ft wing will have a single spar at 35 per cent of the 4ft 9in chord, double-slotted slats and, possibly, spoilers. The areas of the outboard fins will be doubled.

The calculated performance of the HDM.105 is as follows (Aerovan figures in parentheses):—

Wing area, 388 sq ft (389); aspect ratio, 21 (5.6); empty weight, 3,219 lb (3,100); max. a.u.w., 6,170 lb (5,800); payload with 50 gal fuel, 2,374 lb (2,123); min. ground run at max. wt., 175 yd (285); to 50ft, 417 yd (625); full-power climb, s-l, 650ft/min (455); at 5,000ft, 500ft/min (240); single-engine at 5,000ft, 65ft/min (—270); ceiling to 118ft/min climb, 18,350ft (7,900); one engine, 2,625ft (negative); level speed at s-l, 133 m.p.h. (120); at 5,000ft, 130 m.p.h. (112); 2,200 r.p.m., 119 (109) m.p.h. at s-l, 121 (106) m.p.h. at 5,000ft.

Bristol Races

THIRD round of this year's series of National Air Races meetings will take place at Bristol Airport, Whitchurch, tomorrow (Saturday, June 11th). The programme will begin at 2 p.m., with a demonstration by Sea Venoms, followed by the first of the class races—that for the Air League Challenge Cup (Proctors) at 2.18.

The subsequent race programme will be interspersed with display items and with scheduled airline arrivals and departures. Among the demonstrations will be those by helicopters from Bristols and Westlands, R.A.F. Vampires and a Provost, a sailplane from the Bristol Gliding Club, and a Tiger Moth of the Bristol and Wessex Aero Club. The flying programme is scheduled to end at about 6 p.m.

The lap distance of the four-legged race circuit is 6 miles; three laps will form the course for the Norton-Griffiths and Grosvenor Cup races, and four laps for the Air League, S.B.A.C., Goodyear and Kemsley Trophy races. Practice flying around the course will take place during the afternoon and evening of June 10th, five practice laps by each competitor being required.

Admission to the public enclosure will be 2s (children 1s) and to the private enclosure 10s; the car parking fee is 2s 6d. Special buses will run to the Airport from the Tramway Centre, Bristol, and the Old Market, Bristol.

Entries for the six races are as follows:—

S.B.A.C. Cup Class.—G. Marler (Falcon Six), R. R. Paine (Hawk Speed Six), Mew Gull entered by F. Dunkerley, F. Dunkerley (Sparrowjet).

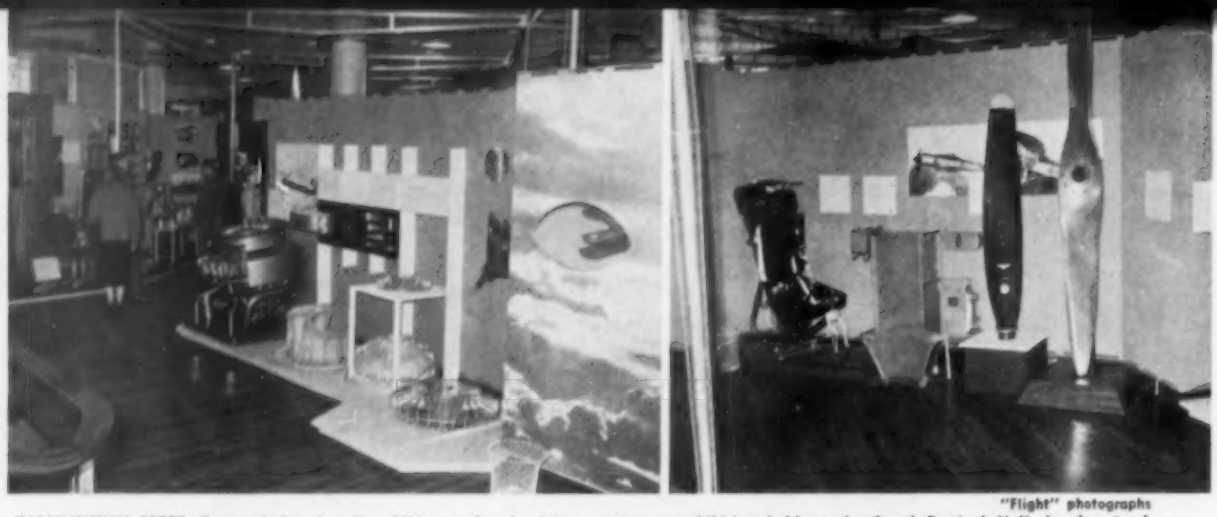
Goodyear Trophy Class.—P. Blamire (Gemini 1a), F. Dunkerley (Gemini 1a), J. N. Somers (Gemini 2).

Air League Cup Class.—A. S. K. Paine (Proctor 1), E. Noel Husbands (Proctor 1), T. G. Knox (Proctor 3), E. Barker (Proctor 3).

Kemsley Trophy Class.—A. J. Spiller (Messenger 2a), D. F. Ogilvy (Comper Swift), J. R. Johnston (Hawk Trainer 3), C. G. Wheatley (Globe Swift), J. N. Somers (Chipmunk), Capt. D. W. Phillips (Hawk Major).

Norton-Griffiths Trophy Class (For Tiger Moths).—B. Maile, P. Vanneck, J. H. Denver, J. M. Donald, B. J. Snook, F. G. Wade Palmer, L. P. Griffith (1st reserve), H. Armitage (2nd reserve), J. A. Greenhead (3rd reserve).

Grosvenor Cup Class.—Miss P. M. Leaf (Tipsy Trainer 1), C. Gregory (Taylorcraft plus D), D. Westoby (Aiglet J.5K), J. E. Appleyard (Chilton D.W.1a), C. Cruikshank (Taylorcraft plus D).



"Flight" photographs

"ALUMINIUM 1955": Some of the aircraft exhibits at the aluminium centenary exhibition held at the Royal Festival Hall, London (and referred to on page 813 of this issue). Items apparent in these two views include an Alvis Leonides helicopter engine, various gas-turbine components, a Martin-Baker ejection seat, Marston Excelsior heat-exchangers, a Rotol airscrew blade, and an historic Fairey-Reed metal airscrew.

FROM ALL QUARTERS...

A.S.T. Open Helicopter School

LAST Friday the Hawker Siddeley Group announced that Air Service Training, Ltd., of Hamble, Hants, are to open a comprehensive school for helicopter instruction. There will be courses "to meet every need. The businessman who simply wants to learn to fly the quickest way from his front garden to the office will be welcome to start from scratch at Hamble. At the other end of the scale, the pilot with thousands of hours who wants to convert to helicopters can also be trained. . . ."

The school will accept all kinds of pupils from service and civil life. Training will also be provided for maintenance engineers to technical licence standards. Flying training will be done on the Hiller 12B. It will be divided into two main categories, a helicopter rating on a commercial licence and a helicopter rating on a P.P.L.

For the former, commercial pilots will be required to undertake a minimum of 43 hours' helicopter flying and, of course, pass the appropriate examinations (A.S.T. point out that they can also take pilots to the commercial pilots' rating on a minimum of 150 hours instead of the normal requirement of 200). Private pilots can obtain a helicopter rating after a minimum of 18 hours on the Hillers; A.S.T. can train to P.P.L. fixed-wing standard from scratch in a minimum of 30 hours.

The first course at Hamble will begin in August. Already pupils have enrolled from the U.K., Western Europe, the Middle East and India.

Irish Air Display

IRELAND'S first air display since 1934 was held during the Whitsun week-end at Weston Airfield, ten miles outside Dublin. Organized by the Aero Club of Ireland, it drew a crowd of almost 50,000 on two days. The Irish Minister for Industry and Commerce, Mr. Norton, who opened the display, complimented the members of the club on their initiative and on the efficiency of their organization.

Over twenty display aircraft were inspected by the Minister, and the machines then took off and flew in formation over the field. Individual performances were given by Capt. P. W. Kennedy, president of the Aero Club and Chief Instructor of Weston Flying School, and by his daughter Rosemary. Highlight of the day's flying, however, was the display of aerobatics given by M. Utterborn, formerly of the Swedish Air Force and now a test-pilot with Saab. Utterborn, flying a Saab 91C Safir, gave a polished display which exhibited both his own skill and the aircraft's versatility.

Two parachute jumps, one from 12,000ft and the other from 2,000ft, were given respectively by Lt. J. Bongeot of the French Paratroop School and by Capt. P. K. Rayner of the Irving Company. At the close of the day's proceedings, fighters of the Irish Air Corps showed their paces in close-formation flying and in a mock attack on a pill-box fort erected at one end of the airfield.

Folland Design Appointment

IT was announced last Monday that Mr. F. J. W. W. Digby, M.A., F.R.Ae.S., formerly chief designer of the Westland Aircraft Co., Ltd., had joined Folland Aircraft, Ltd., on June 1st as "an assistant chief designer for work on impending projects." In making the announcement, Follands add that the development of the Gnat will remain the responsibility (under Mr. W. E. W. Petter, managing director and chief engineer) of Mr. J. Boulger, who has been assistant chief designer since March, 1951.

After taking an Honours degree in engineering at Cambridge University, Mr. Digby joined the Westland technical office. He later became assistant chief designer, and in that capacity was associated with Mr. Petter, then Westland's technical director, in the design of the Lysander, Whirlwind and Welkin.

Mr. Digby was appointed Westland's chief designer in 1944 and produced the designs for the Wyvern and its developments. It is believed that one important reason for Mr. Digby's decision to part company with Westland is his keen interest in fixed-wing aircraft. The Yeovil company have not turned their attention exclusively to helicopters, but no new fixed-wing designs have been announced.

Foundation of Knowledge

ON Friday last week Sir John Wenham, J.P., Chairman of Surrey County Council, laid the foundation stone of the new Vickers-Armstrongs apprentices' training school building at the company's factory at Weybridge.

Due for completion this August, the building is to accommodate 750 apprentices, with classrooms and completely equipped machine shops. The opening will mark the 21st year of the Vickers apprentice training scheme, which started with 13 pupils, and by 1950 had reached 250. Mr. G. R. Edwards (managing director, aircraft division), in an address before the ceremony, said that the industry's efficiency depended to a marked extent upon the availability of well trained technical staff, and that this was Vickers' attempt to ensure that they would be forthcoming. The first apprentice to join the company was still serving with it now.

The architect of the building, Mr. A. H. Ley, and several representatives of local education authorities and institutions were also present at the ceremony.

WHITSUN AT WESTON: At the Irish Air Display (reported above), Mr. David Montgomery, hon. secretary of the Aero Club of Ireland, received the Irish Shell Trophy from Mr. Norton, Minister of Industry and Commerce. Capt. Kelly-Rogers of Aer Lingus is on the right.

YPENBURG IMPRESSIONS

More About the Ilsy Display

PERHAPS the Dutch Meteor formation shaping the letters "F.A.I." was not as perfect as one has come to expect at Ilsy displays but, in the air above Ypenburg, this was soon overshadowed by the excellence in flying which followed, from the "50" formation flown by the Sabres of 512 Squadron, U.S.A.F., to the final massed fly-past of N.A.T.O. jet fighters some two and a half hours and 31 items later. The occasion (reported briefly last week) was Ypenburg's fifth International Air Display, combined this year with the Golden Jubilee Air Display of the F.A.I.

Following formation Grunau aerobatics by a trio from R.N.A.F. gliding clubs, and an all-too-brief demonstration of the Auster A.O.P.9 by Ranald Porteous, a misunderstanding between pilot and control prevented the German glider-pilot Albert Falderbaum from giving his planned aerobatic display. Agile cavorting by Juhani Heinonen in his home-built HK-1 ultra-light was followed by the humorous antics of the French Lignel 44 flown by Louis Clément, including a low, yawing, "no-hands" pass.

The sun, glinting on cobweb-fine arcs, revealed that the three Dutch Harvards were literally tied together for their impeccable tight formation work. This trio, shown above, was led by G. J. Slag. After a 50-aircraft fly-past by representative types of the Netherlands Naval Air Service and the Royal Navy, twelve R.N. Seahawks smoothed themselves across the loud blue sky, and then split to present a brace of formation fours in a well timed, vapour-punctuated piece of aerobatic show-business. Squadrons 800 and 807, led by C.O.s Lygoe and Hutton, were responsible.

Taking part in the helicopter circus were an S.O. 1221 Djinn, a Hiller 12B, a U.S. Army Bell 47D, and three S.55s; one a white-topped airline vehicle from Sabena and the other two in Dutch Navy blue. From one of the Naval machines, a rating was efficiently dunked into the downwash dust clouding up from the runway. After a rocket-assisted take-off by two Fireflies, Pat Fillingham brought Heron G-AMTS over in a businesslike run.

Presumably few of the vast crowd at Ypenburg had seen or heard either Sopwith Pup or Bristol Fighter before. Certainly they appeared most appreciative of the dogfight next presented, between W/C. R. F. Martin in the Pup and Lt-Cdr. W. Stuart (with Mr. L. A. Jackson of the Shuttleworth Trust as gunner) in the Fighter. But it was the treble supersonic bang, as the Pup hissed Bristol-wards in a purposeful dive, that started the crowd murmuring aloud—and the fast low pass right through the dogfight by the true originator, Sonderman's Hunter, that shook them in their seats as nothing else in that brilliant programme could. The dogfight continued.

In swift succession, the programme items were ticked off. A Super Constellation of K.L.M.; brilliant solo aerobatics by F/L. Peterson, R.C.A.F., in an Orenda-Sabre; Britannia G-ANBA, elegantly displayed by Bill Pegg; a stately run by four Canberras from 2nd T.A.F.; over 50 drops by Dutch, French, Jugoslav and Turkish parachutists; aerobatics by a red-nosed Dutch Meteor and by five Dutch Thunderjets; and searing low beats by two U.S.A.F. F-86D Sabres.

Good formation rolls were featured by the four Venoms of 266 Squadron, R.A.F., led by F/L. Robert Kendell, which preceded the aerobatics of the solo Hunter flown by F/L. Jenkins and of the Hunter trio led by S/L. Lelong. While the Hunter formation lacked nothing in polished execution of the various manoeuvres, it stayed too high and too far away from the crowd to take top place on such a highly competitive bill.

After the most lively throwing-around of two Fokker S.14 Mach Trainers (one Nene, one Derwent-powered) by Sonderman and Moll, came the tight, professional precision of the Skyblazers team—four F-86D Sabres of the 48th Fighter/Bomber Wing, U.S.A.F., led by Capt. William Dillard. A double bang and Maj. "Chuck" Yeager entered, travelling with rapidity and his F-86D, followed by a lone B-47. Yet more formation aerobatics—by four Thunderjets of the Italian Air Force—and more supersonic banging (by three Orenda-Sabres of No. 4 Fighter Wing, R.C.A.F.) preceded the final massed fly-past by Ouragans, Sabres, Meteors, Thunderstreaks and Thunderjets.

The afternoon had been a rich feast of display flying at its best. Mr. P. J. Yperlaan, secretary general of the Royal Netherlands Aero Club, could now relax from organizing a most successful show—and could turn to the question of broken windows in the Hague, Delft, Rijswijk and Voorburg. K.T.O.

Harvards of the Netherlands Government Flying School, with a Navy S-55 awaiting its cue.

Hunter trio—from 43 Squadron, R.A.F.

Below, looking after the Shuttleworth Pup: "Dicky" Martin, L. A. Jackson, "Doc" Stuart, and A. Cdre. Wheeler.

Bottom, Capt. Bartlett, F.A.I. president (centre), with Mr. B. Stephon and the Burgomaster of Rijswijk, the local district.

"Flight" photograph

"Flight" photographs

HERE AND THERE

France Entertains . . .

FLIGHT demonstrations on June 18th and 19th at the Salon de l'Aeronautique (which begins at Le Bourget today, June 10th) will include aerobatics by four teams—Dassault Ouragans of the Patrouille de France; three Fouga CM.170 Magisters from Mont-de-Marsan; a British team on Hawker Hunters; and the U.S.A.F. Skyblazers, with their F-86D Sabres.

. . . Lands High . . .

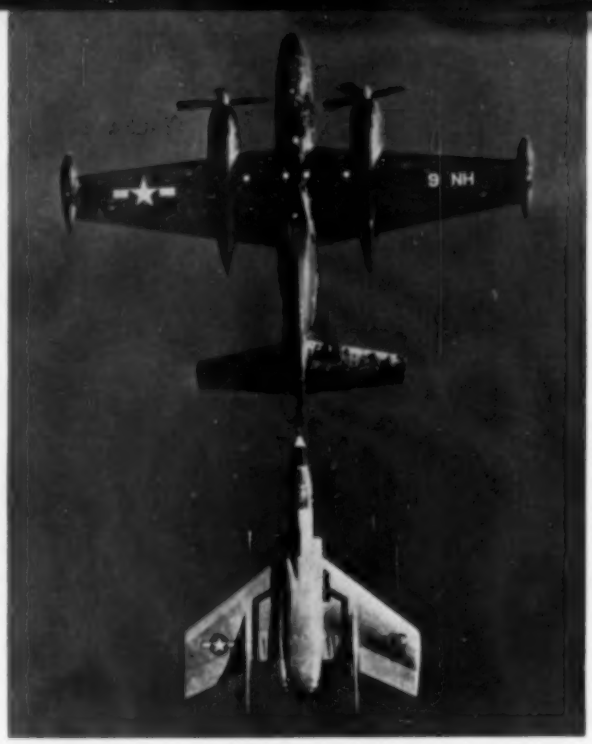
FLYING a Bell 47G, M. Jean Moine, accompanied by the guide Contamine, took off from Le Fayet airfield (1,905ft) on Monday and landed first on the Dôme du Goûter (14,116ft) and, seven minutes later, on the summit of Mont Blanc (15,782ft). On the same day S.N.C.A.S.E. claimed the world's helicopter height record when the Alouette II, powered by a Turboméca Artouste, reached 27,100ft. The machine took off from Buc, near Paris, climbed for 42 min and landed at Montesson. The pilot was M. Jean Boulet.

. . . Climbs Supersonically . . .

IN a slight climb, France's S.0.9000 Trident turbojet-cum-rocket fighter-research prototype has now attained 920 m.p.h. Test pilot Charles Goujon, who made the flight from Melun, is said to have used only two of the three barrels of the SEPR liquid-fuel rocket. The Trident also carries two Armstrong Siddeley Viper turbojets mounted at the wing-tips. At full power it should attain 1,100 m.p.h. on the level.

. . . and Flies Fast

IT is reported that on May 31st Jacqueline Auriol set up a new women's speed record by flying "an Avon-engined Mystère" (either the IVB or the IVN) over a 15-km course near Brétigny at a mean speed of 708.362 m.p.h. The previous women's record (674.187 m.p.h.) was held by Jacqueline Cochran, of America, with a Sabre.



THIS LITTLE PIGGY . . .

There is something of the farmyard about this singularly striking view of a U.S. Navy F7U-3 Cutlass refuelling from a weather-worn AJ-2 Savage tanker near the Cutlass's base at Atlantic City, New Jersey.

THE PARIS STORY

THERE is every indication that the Paris Aero Show will be one of unprecedented interest, more especially since the French aircraft industry has—as explained in an article in this issue—really got into its stride. Next week's issue of *Flight* will provide a first-hand, fully illustrated report of the Show. The following week's issue, appearing on June 24th, will contain an appraisal of technical trends evident in Paris, together with a report of the big flying display with which the show will conclude.

Breaking the Bottleneck

HELICOPTER deliveries of engineering tools from Sheffield to Manchester, Birmingham and London were made last Friday by Firth Brown Tools, Ltd. The firm were determined that, despite the rail strike, the deliveries should be on time, so a WS-51 was obtained from Westland Aircraft, Ltd., at Yeovil and flown to Sheffield, by test pilot Jack Fraser. Some 300 lb of tools were put on board.

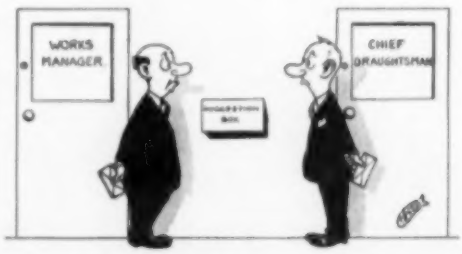
A Valiant for Woomera

A VALIANT B.1 is shortly to fly to the rocket range at Woomera for special bomb trials. So far, Lincolns and Canberras have been used for bomb ballistic tests; the Valiant will, of course, be able to carry out such trials at higher speeds and altitudes. It will also give the R.A.A.F. experience of operating aircraft of this type in local conditions. Five R.A.A.F. officers (two pilots, two navigators and a signaller) are at present on a Valiant conversion course. The chosen B.1 will shortly leave the production line.

ELAND ODYSSEY: Now on a world tour to bring facts about the Eland turboprop to the notice of airline operators is Mr. W. E. Hampton (right), Napiers' aviation expert representative. He is seen with "Mike" Rondrup, chief test pilot, in front of the Eland-Vorsity.

The B-52 Fleet

FIVE hundred Boeing B-52 heavy bombers should be in service with the U.S.A.F. by 1958, as the result of an increase in production rate of 35 per cent. As intimated in a leading article last week there has been grave concern in some U.S. quarters that America is in danger of losing air supremacy to the Russians, and the stepped-up bomber production is directly attributable to this uneasiness. Output of supersonic fighters may be increased next. The first B-52s will be going to operational units later this summer.

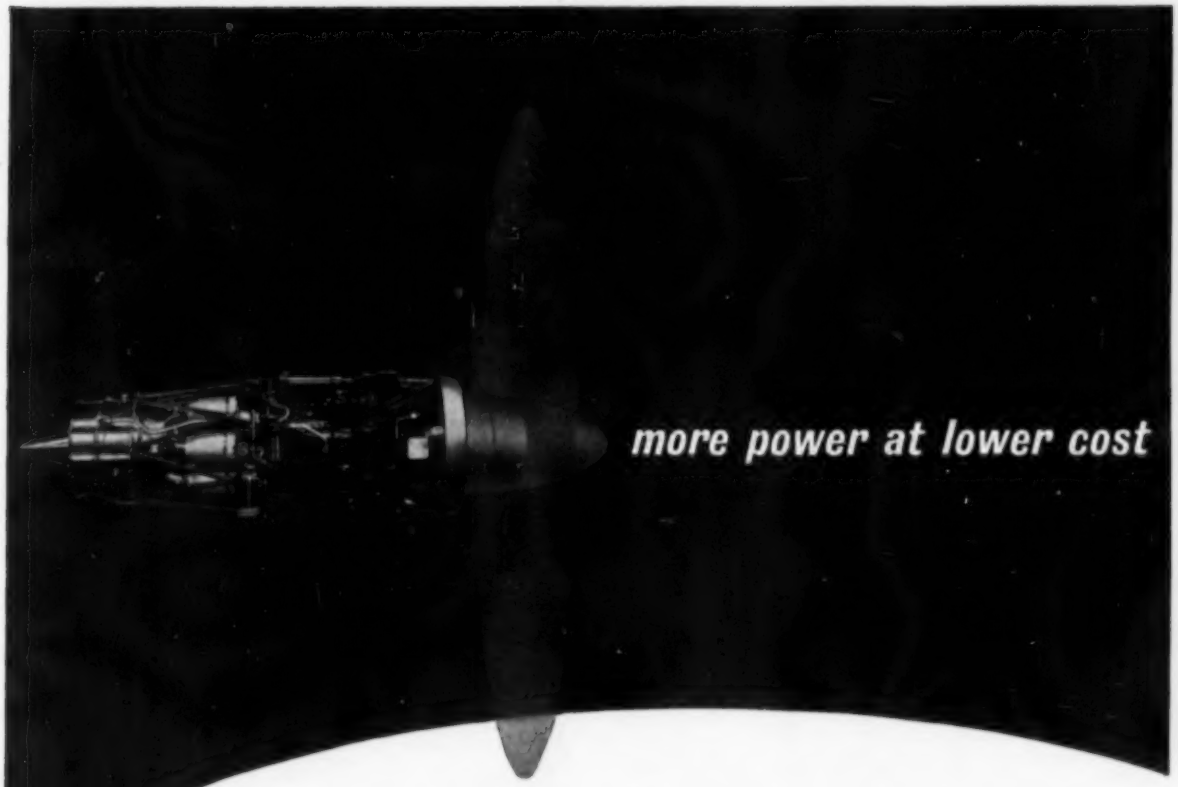


Twenty-four Hours at Speed

MANY of our readers are, we know, intensely interested in motor racing; we accordingly remind them that next Friday's (June 17th) issue of *The Autocar* will contain a feature of exceptional interest—the detailed illustrated report of the Le Mans 24-hour race.

German Jet Training

THE first men of Western Germany's armed forces to be called up will be about 200 pilots who will begin a NATO jet conversion course in Germany shortly. They will be followed by a number of German staff officers who will complete a staff course at NATO H.Q. in Paris. The organization of the revived Luftwaffe was outlined in an article in *Flight* of May 20th last.



more power at lower cost

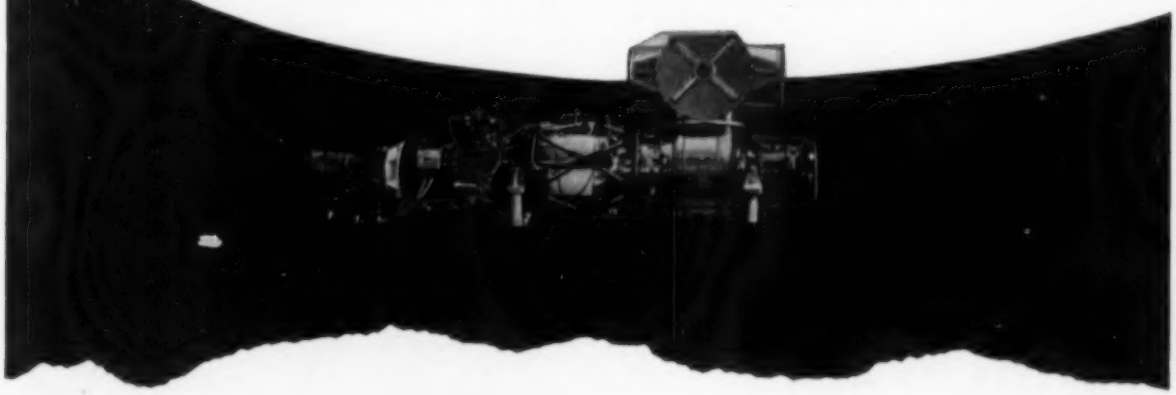
ELAND: This important turbo-prop engine has reached the type test stage at its initial rating of 3,000 e.h.p. On development is a 4,000/4,200 e.h.p. version. Napier are installing Elands in an Elizabethan and a Convair 340 for demonstration and test purposes.

ORYX: Napier's 750 gas h.p. turbo-gas-generator for helicopters propelled by jet reaction at the rotor blade tips. It weighs less, is less complicated and easier to maintain than conventional helicopter power systems. Now being developed as a power unit for the Percival P74 helicopter and the Fairey Rotodyne.

SPRAYMAT: De-icing sprayed on—can follow any contour. Weight and power consumption lower per unit area than any other method capable of meeting design requirements.

DELTIC: 825-2,500 b.h.p. diesel engine—the smallest and lightest for its power output in the world. This means more cargo space in freighters and higher speeds for naval craft.

TURBO-BLOWERS: Double the power of 4-stroke diesels; increase the power of 2-strokes by more than 30%. Available for diesels of 140–4,000 h.p. afloat and ashore: multiple installations for higher powers. Currently in service in 37 countries.



NAPIER see STAND Nº30 *Paris Air Show June 10th-19th*

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CBC 89

If it's a case for investigation

Plunging below the surface of a problem to probe its hidden depths is an old-established custom of ours.

During the fifty years in which we have been serving the British aircraft industry we must have investigated and provided the answers to a thousand and one different headaches. This lengthy and varied experience has put us in the position of being able to provide a technical service for manufacturers that is second to none. Being right in at the beginning of a problem makes us feel very much at home and the tougher it is the keener we are to get our teeth into it.

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Man of the moment at Toulouse on May 27th was M. Pierre Nadot, who commanded the S.E. Caravelle on its 22-minute maiden flight (right). The layout of the two aft-mounted Avon turbojets is well shown at the foot of the page; M. Nadot is seen emerging in this post-flight view.

CIVIL AVIATION

BRITAIN'S NEW MIDDLE-EAST INTERESTS

DEVELOPMENT of air transport in the Middle East should be considerably accelerated by the formation of a new aviation company in which British, Lebanese and Arab interests are combined. The company will be based in Beirut and will be known as the Mideast Aircraft Service Company (M.A.S.C.O.).

Plans for its formation were announced on June 3rd by B.O.A.C. and Hunting-Clan Air Transport, who are jointly concerned in the establishment of the company. The announcement said that a second British independent airline, Skyways, was also expected to participate.

The primary function of M.A.S.C.O. will be to provide airlines in the Middle East with modern aircraft—including, it is announced, three of Hunting-Clan's Viscounts—and also to furnish the associated servicing facilities and to train technicians. It is intended, the announcement adds, that M.A.S.C.O. will become the maintenance centre for all companies associated with B.O.A.C. in the Middle East. These companies are Aden Airways (with whom are associated Arab Airways), British International Airlines and Gulf Aviation. As a start, Field Aircraft Services, Ltd., the maintenance associates of Hunting-Clan, are collaborating with B.O.A.C. to provide accommodation and equipment at Beirut.

The Middle East is potentially an important market for British Civil Aircraft, though as yet it has not been fully tapped. Formation of the new supply-and-service company should assist several airlines in overcoming the problems which have until now frustrated their hopes of re-equipment.

SEVEN SEAS AND 7Bs

CONSTRUCTION of the first of the 87 DC-7C Seven Seas now on order is proceeding on schedule, report the Douglas Aircraft Co. The announcement, dated May 26th, added that the centre wing spar had then been completed and that fuselage assembly would begin early in June. Mating of wing and fuselage is scheduled for early September, and Douglas say that the aircraft will roll out of the final assembly hangar early in November to make its first flight before the end of the year.

The Douglas statement does not refer to the first DC-7C as a prototype, so it is possible that it will be delivered as a production aircraft to Pan American—first of the eight airlines to have ordered Seven Seas—on completion of certification tests. Deliveries of DC-7Cs are due to begin early in 1956.

Certification of the DC-7B, an improved version of the DC-7 now in service on United States domestic routes was announced by Douglas on June 1st. The company stated that the aircraft met or exceeded all design specifications, and quoted the following examples of improvement on contractural requirements: "Actual take-off gross-weight of 126,000 lb instead of the guaranteed 125,000; actual take-off field length of 6,100ft, compared to the guaranteed 6,500, and actual landing field length of 5,800ft, compared to the guaranteed 5,990 (figure based on 102,000 lb maximum landing weight)."

New features of the DC-7B include the use of latest-type (DA4) Turbo-Compound engines; the fitment of spinners to improve cooling and reduce drag; and a flap linkage system giving improved take-off performance. "Overwater" versions of the DC-7B, as ordered by PanAm and South African Airways, have saddle tanks each carrying 220 U.S. gallons of fuel; top-surface fairings of the nacelles have been extended rearward to house these tanks, which increase the maximum still-air range of the aircraft from 4,430 to 5,120 miles. First deliveries of DC-7Bs were due to be made last week to P.A.A. and Eastern Air Lines (who have ordered the domestic version).

'SUPER-SUPER' CONSTELLATIONS FOR FRANCE

AN order from Air France for twelve L-1649A Super Constellations was announced by the Lockheed Aircraft Corp. on June 3rd. The aircraft will be delivered in the spring of 1957 for non-stop service between Paris and New York.

The French flag carrier is the second airline to order the new Lockheed, a thin-winged, longer-range version of the Super Constellation; T.W.A.'s order for 24 of these aircraft was announced in April. The value of the 36 aircraft sold to date is estimated at £37.5m.

Lockheeds claim that their new airliner, powered by four 3,400 h.p. Wright Turbo-Compounds, will be capable of carrying 58 passengers for 6,500 miles at a cruising speed of over 350 m.p.h. and that it will fly from Paris to New York in nearly three hours less time than the DC-7C when carrying the same payload as its Douglas competitor. A detailed performance comparison of the two aircraft was published in *Flight* last week.

THE COMET OUTLOOK

PRESENTING the annual report of the de Havilland Aircraft Co. on May 27th, Mr. W. E. Nixon, chairman, affirmed that in the Comet 4 the company once again saw the possibility of earning "a foothold in the world market for mainline aircraft, from which the British aircraft industry may progress in years ahead."

Summarizing progress made since the conclusion of the Comet Inquiry, Mr. Nixon said:

"Flight trials of the Comet 3 began in July of the year under review and have gone on continuously. As an improved type of the Avon engine, the RA.29, is to be made available, we have decided to produce a superior aircraft, the Comet 4, incorporating the new power unit and having greater fuel capacity and other refinements. The British Overseas Airways Corporation announced in March that in view of these developments and for reasons of standardization and the timing of their fleet requirements, they would order 20 of the new Comet 4s for their main jet travel operations. We expect to commence deliveries in 1958 . . .

"The Comet 4 will cruise at 500 miles an hour, with a degree of

CIVIL AVIATION...

smoothness and comfort even surpassing that of earlier versions, and will carry its capacity payload of nearly 60 first-class passengers on practically all of the established inter-continental stages, including the few which exceed 2,500 miles. To fulfil this world-wide function economically appears to us more worthwhile than the ability to fly with full load non-stop from London to New York against prevailing westerly winds of both fair and adverse seasons, but even on this route the new Comet, with one halt westbound, will probably afford the fastest and favourite means of travel.

"The principal carriers have been quick to see the significance of the capabilities of the Comet 4 and they appreciate the wealth of experience which is being built into it, and to which there is no short cut. No airliner design has been so thoroughly scrutinised and tested, and it is important to recall that the Comet has behind it 30,000 hours of airline operation which, apart from the one problem now resolved, was highly satisfactory."

Further information on the Comet 4 comes from a "preliminary statement" issued by de Havillands on May 26th; its contents are summarized in the following notes:—

Structure. Advantage has been taken of recent advances in the knowledge of metal fatigue and during the past months a great deal of repeated-load testing has been undertaken on full-scale components. In particular the stress level in the fuselage seam joints and cut-outs has been kept low so that local damage will not affect the safety of the structure: the integrity of the new structure will be beyond question.

Power Units. The Avon RA.29s of the Comet 4 will each deliver 10,500 lb s.t. for take-off, compared with 10,000 lb for the Comet 3's Avon RA.26s. Cruising specific fuel consumption will be about 9 per cent lower. Reverse thrust is under active development for the Comet 4, but present figures do not allow for it.

Weight and Loadings. Maximum take-off weight of the Comet 4 will be 152,000 lb, compared with 150,000 lb for the Comet 3. Usable fuel capacity is increased by an unspecified amount to a total of 8,750 Imp. gal. Capacity payload of the Comet 4 will be 16,850 lb (58 passengers plus luggage, mail and freight). Equipped tare weight is quoted as 68,000 lb and maximum landing weight is 113,000 lb. It is hoped that the introduction of titanium will bring reduced structure weight, and that early production aircraft will benefit in this way.

Take-off performance, say de Havilland, will very rarely be a limiting factor. In general, the Comet 4 will take-off 3,500 lb heavier than the Comet 3 for a given runway length. An example of Comet 4 take-off performance is as follows: 7,140ft (2,380 yd) to 50ft, with failure of one engine at critical point; sea level altitude and temperature of 30 deg C (86 deg F).

Speed. Optimum cruising speed of the Comet 4 will correspond to a Mach number of .74, which is equivalent to 489 m.p.h. in standard atmosphere, rising to 506 m.p.h. in I.S.A. plus 15 deg C conditions.

Payload-range Performance. Stage-lengths with capacity payload of 16,850 lb will be 2,870 miles; this example of typical performance assumes a continuous headwind of 50 m.p.h. and the necessary fuel reserves, including allowances for a 30-minute stand-off at 1,000ft followed by a 200-mile diversion from sea level. The maker's studies show that the Comet 4 will carry its capacity payload with 85 per cent regularity or better over the great majority of the important trunk routes.

Examples of forecast Comet 4 journey times from London to five major cities are: to Tokyo (9,386 miles) with four intermediate stops, 22 hr 3 min; to Sydney (11,164 miles) with four stops, 27 hr 37 min; to Johannesburg via Cairo and Nairobi (6,220 miles), 15 hr 23 min; to New York (3,502 miles) with one stop, 9 hr 30 min. Estimated flight time from San Francisco to New York (2,612 miles non-stop) is 5 hr 18 min.

I.A.T.A. FORESEE NEW NAVAIDS

WITHIN five to ten years it may be possible to equip airliners with automatic airborne navigational aids which will be completely independent of ground stations. This intriguing possibility was among the topics discussed by delegates to the eighth Technical Conference of the International Air Transport Association at San Juan, Puerto Rico. A post-conference summary by I.A.T.A. included the following reference to the subject:—

"One such aid which was examined—within certain security limitations—was the 'inertial navigation' system. This system employs the physical properties of near-perfect gyroscopes to provide a continuous indication within the aircraft of true horizontal and vertical. In conjunction with these references, accelerometers are then used to determine the instantaneous velocity of the aircraft and the distance and direction it has travelled. Finally computers can be added which will permit presentation of the navigational information in any required pictorial or symbolic form.

"The maximum accuracy possible with inertial navigational devices was not disclosed but the hope was expressed that errors would not exceed one or two miles in position per hour flown. Since such errors would be independent of the distance flown, aids of this type would be increasingly attractive as aircraft speeds advance. The conference strongly underlined the point that there are many sound operational reasons why inertial and other self-contained aids will not eliminate the continuing need for ground-referenced radio navigational aids."

Discussing air traffic control the delegates agreed that future turbine-powered aircraft would reduce flexibility in the choice of cruising altitudes and that consequently it would become necessary to make extensive use of aircraft separation in the horizontal plane. There would, in turn, be a requirement for navaids permitting procedures to be based on finer lateral and longitudinal limits of separation.

The conference also pointed to the need for revision, in the light of present-day traffic densities and speeds, of criteria determining whether flights should proceed under visual or instrument flight rules. It was concluded that V.F.R. flights should be permitted only under the following conditions: pilot's forward visibility of at least five miles; minimum lateral distance from cloud, 2½ miles; minimum distance above cloud, 2,000ft; and vertical distance below cloud of at least 1,000ft. The conference also reaffirmed the I.A.T.A. view that, ultimately, all air traffic should be subjected to positive control, irrespective of weather conditions. It was agreed that, in the interim, revision of V.F.R./I.F.R. criteria on the lines indicated would increase the percentage of aircraft under control in marginal weather.

AIRLINE PILOT TRAINING

ALL-THROUGH flight and ground training, *ab initio* to the Commercial Pilot's Licence and Instrument Rating standard, is now being provided by the London School of Air Navigation in conjunction with Airways Aero Associations, Ltd. The new courses, recently approved by the M.T.C.A., have been put forward by Mr. Ian McNicol, director of the L.S.A.N., both as an immediate facility and as a future line of entry into the profession should the need for a regular civil-aircrew training scheme become officially recognized.

The ground subjects for C.P.L. and Instrument Rating will be taught by the London School at its headquarters at 33, Ovington Square, London, S.W.3. Flying instruction, at Croydon, will be the responsibility of Airways Aero Associations which, in addition to running the Airways Aero Club for personnel of the two Corporations, has performed outside contract work for some time. During 1954, total flying hours amounted to over 5,600, including almost 3,000 hr devoted to commercial-pilot training for B.E.A. radio officers and B.O.A.C. navigators, and 450 hr on A.T.C. scholarship flying.

As a long-term policy, a three-year apprenticeship scheme for civil pilots has been suggested by Mr. McNicol, under which the initial cost of training would be borne by the operators. Selected candidates, of P.P.L. standard, would undergo one year with the operator's maintenance department and other technical sections, a second year being trained to C.P.L. standard by an outside training organization, and a third year of advanced type and route experience as junior pilot or navigator with the operator. Indentured for the next five years, the pilot would repay over this period part of his training expenses. No comment on this proposal has yet been made by either of the Airways Corporations, who would presumably be the main British operators concerned in such a scheme.

BREVITIES

FORMAL United States certification of the Viscount will be marked by a handing-over ceremony in London on June 13th. At the ceremony, Mr. Fred B. Lee, administrator of the C.A.A., will present type certificates for the Viscount, its Dart turboprops and its Rotol airscrews to representatives of, respectively, Vickers-Armstrongs, Rolls-Royce and Rotol.

* * *

Tokyo Airport's new £1m terminal building was officially opened on May 18th. A Qantas Super Constellation, operating a scheduled service to Sydney on May 20th, was the first international aircraft to use the new terminal.

* * *

Seaboard and Western Airlines announce the opening of a sales office and cargo depot in Boston. The airline, which has just completed eight years of non-scheduled transatlantic freight services, now operates four Super Constellations and six DC-4s.

On June 2nd Britannia G-ANBA flew from Filton to Belfast, where the aircraft was inspected by Government officials and by representatives of Short Bros. and Harland, Ltd., who are setting up a second line for production of the type. Aboard the aircraft was Bristol's chairman, Sir Reginald Verdon Smith, who conveyed a goodwill message from the Lord Mayor of Bristol to the Lord Mayor of Belfast.

* * *

The inauguration of B.E.A.'s helicopter service between the South Bank and London Airport, due to have taken place this month, has been postponed pending further development of the silencer fitted to the float-equipped S-55s which will operate the service. During trials, the silencers over-heated to the extent that holes were burnt in them after a comparatively short period of use; another result of the trials is that B.E.A. are negotiating with the London County Council for a larger site at the South Bank.

The scene on the Western Lawns at Eastbourne as the delegates paraded. In the foreground: the R.A.F. Central Band, and "Lewis," the goat.

DUKE of EDINBURGH PRESIDES at R.A.F.A. CONFERENCE

THIS year's conference of the Royal Air Forces Association, marking the silver jubilee of the organization, was honoured by the presence of Marshal of the Royal Air Force the Duke of Edinburgh, the Association's president, who took the chair during the major part of the proceedings. Held at Eastbourne last week-end, the conference was attended by delegates representing 700 branches at home and abroad; other R.A.F.A. members and their friends and relatives brought the total number of visitors to some 2,000.

The Duke arrived from Buckingham Palace in a Naval Whirlwind helicopter at noon on Saturday, landing on the sea front's Western Lawns. As soon as the afternoon session opened, in the big concert-hall of the Winter Garden, he took over the chair, on a platform crowded with R.A.F.A. Council officials, several of them R.A.F. officers of high rank. Among these were Marshal of the Royal Air Force Lord Tedder (an honorary vice-president), Air Chief Marshal Sir Frederick Bowhill (vice-president), and Air Marshal Sir Robert Saundby (chairman of National Council); serving officers present in an official capacity included Air Chief Marshal Sir Francis J. Fogarty, Air Member for Personnel.

In his presidential address, the Duke spoke of the bond that existed between people who had shared the same sort of experiences; it was the business of the R.A.F.A. to make use of that bond of mutual confidence to look after the interests of the less fortunate, the unlucky and the unhappy. Although the Association could do a very great deal in such ways it could also do a lot for the Royal Air Force itself, for many people formed their judgement on a Service from what they saw of its ex-members.

"It is very important," continued the Duke, "that the public at large should feel, through you, that confidence in the Royal Air Force which is rightly deserved. Every one of you here has had a hand in shaping the Air Force of today and I hope you are properly proud of it. I have recently been able to see quite a lot of the Royal Air Force, the people who serve in it and some of its problems, and I want you all to know that I was very pleased with everything I saw. The Service is in very good heart, fully conscious of its responsibilities, and thoroughly determined to meet them to the best of its abilities."

The Duke concluded by mentioning some aspects of the R.A.F.A.'s work—pensions, legal advice, employment and financial assistance, help for the disabled, and so on: "The value of this work over the years cannot be calculated. It is your work; you should feel proud at what has been achieved and encouraged to continue and expand it in the future."

Subjects covered by the conference included organization, pensions, welfare, rules and regulations, and Battle of Britain Week and Wings Day, and under each of these headings numerous resolutions—there were 99 on the agenda—were moved, debated and voted upon. And here it may be remarked that the Duke of Edinburgh was anything but a "figure-head" chairman; he enforced the rules of procedure firmly, yet with an air of informality—and many a keen flash of wit—that was particularly appropriate to a gathering of this kind.

He took the chair again on the Sunday morning—now using as a gavel a silver-mounted shillelagh which had been presented to him by Dublin R.A.F.A. branch at the dance the previous evening. The social side of the conference, incidentally, was as crowded as the business agenda; it even included a midnight matinee of *The Dam Busters* film.

Sunday's discussions were preceded by a memorial Service on the Lawns, conducted by Canon A. S. Giles, Chaplain-in-Chief of the R.A.F.; the Duke read the lesson, and later took the salute at a march-past. Four Meteors of No. 500 (County of Kent) Squadron, from West Malling, flew over in salute as the Duke arrived. The scene, in brilliant morning sunshine under a cloudless sky, was a memorable one, with the hundreds of blue-and-gold standards of the branches seen against the background of Beachy Head and the imposing white-painted buildings of the sea-front, many of them flying R.A.F.A. flags. The Central Band of the R.A.F., under W/C. A. E. Sims, provided the music, and the parade of R.A.F.A. members (R.A.F., W.R.A.F., and A.T.C. detachments also participated) was commanded by Mr. G. R. Boak (general secretary) with the same remarkable efficiency that he displayed in putting the organization of the conference into effect.

At the Sunday afternoon session of the conference financial matters were discussed, and A. Cdre. J. Swire Griffiths (hon. treasurer) pointed out that, if the R.A.F.A. was to be maintained in its present form, increased membership was essential (to which *Flight* may add that the subscription is a modest one, with a good deal offered in return).

Successful in every way, the conference was, unhappily, shadowed by a tragic and as yet unexplained occurrence: on Saturday morning an R.A.F. Sunderland, which was to have been moored off the beach during the week-end, sank almost immediately on alighting close inshore. In spite of quick rescue work by R.A.F. tenders and other craft, the captain and three crew-members lost their lives; of ten others, three were seriously injured. Later, at the conference, the Duke of Edinburgh despatched on behalf of the delegates a message of sympathy to the next-of-kin, and special arrangements were put in hand, through the R.A.F. Benevolent Fund, to offer any financial assistance they might require.

The Duke of Edinburgh gives his presidential address to the R.A.F.A. in the Winter Garden. On the table are trophies awarded for achievements by the branches.

Memorial to Bomber Crews

A MEMORIAL to the officers and airmen of Nos. 2, 3, 8 and 100 Groups, Bomber Command, who lost their lives during the war will be unveiled in Ely Cathedral on November 6th.

The memorial will be a stained-glass window with four lights or panels installed in the north side of the nave. The left-hand light will show the figure of a member of aircrew in flying clothing above the badge of No. 2 Group. The left-centre light shows the Archangel Michael above the badge of No. 3 Group. The right-centre light portrays St. George and the Dragon above the badge of No. 8 Group. The design also includes the Lion of St. Mark, the Patron Saint of the Royal New Zealand Air Force. The right-hand light shows the figure of an airman above the badge of No. 100 Group. At the bottom of each light are scenes showing Wellington bombers during different phases of an operational bombing sortie.

In the tracery at the top of the window are displayed the badges of the Royal Air Force, Royal New Zealand Air Force and Bomber Command, together with the

SERVICE AVIATION . . .

emblems of the various Allied Forces who fought with Bomber Command. Particular emphasis is placed on the R.N.Z.A.F. as large numbers of New Zealand aircrews served with No. 3 Group. At the bottom of the two centre lights is written: "In honour and memory of the members of Nos. 2, 3, 8 and 100 Groups who served in the Ely district during the Second World War, 1939-45."

The window has been designed by Mr. E. Liddall Armitage, Chief Designer at the Whitefriars stained-glass studios of James Powell and Sons, Ltd.

Naval Appointment

THE Admiralty has announced the appointment of Vice-Admiral M. Richmond, C.B., D.S.O., O.B.E., to be Flag Officer (Air) Mediterranean, in succession to Vice-Admiral J. P. L. Reid, C.B., C.V.O.

New Fighter Group

ON May 30th the Air Ministry announced the formation of a new group—No. 13—in Fighter Command, with headquarters at Ouston in Northumberland. It is commanded by A.V.-M. W. G. Cheshire.

The new group will take over some of the functions of No. 12 Group. During the war, the former No. 13 Group shared with No. 14 the defence of Scotland.

Benevolent Fund Appointments

IT is announced that Marshal of the Royal Air Force Sir William Dickson, Chief of the Air Staff, has been elected a vice-president of the Royal Air Force Benevolent Fund.

Sir James Barnes, who retires next month, having been Permanent Under-Secretary of State at the Air Ministry since 1947, has been elected a member of the Fund's Council.

No. 264 SQUADRON CELEBRATES

AT a dinner, held on May 26th, No. 264 Squadron celebrated the 15th anniversary of the unit's becoming operational. S/L. H. M. H. Tudor, D.F.C., the C.O., welcoming a number of ex-members, regretted the absence of Walter Gibb, assistant chief test pilot at Bristols, who was with 264 during the war.

W/C. E. G. Barwell, who was with the squadron when it was first formed—and equipped with Fairey Battles and Magisters!—gave the assembled company a graphic description of the five days in May 1940, when the unit, flying Boulton Paul Defiants, claimed 57 enemy aircraft shot down, 37 of them in one day. This score, he thought, was "pretty genuine." He described how, on May 31st, he had seen one of the squadron Defiants disintegrate in the air; and how, to his surprise, when he himself was later being picked up by a destroyer after ditching, he found the pilot, Mike Young, on board unharmed.

W/C. Hughes gave a brief survey of the squadron's first attempts at night fighting, both "cat's eyes" and using pilot-operated A.I. The first success, he said, came when one of the Defiants flew by accident with navigation lights showing—tempting a German bomber to have a go, thereby giving his position away.

A more up-to-date story was that told by S/L. Peter Scott, test pilot at Boscombe Down, who spoke of the Javelin. His description of the easy flying characteristics of this new all-weather fighter was "Go to Moreton Valence in the morning—fly the Javelin after lunch." He did not, however, speculate as to when, or in which unit, the Javelin would first see service. (The Air Minister has said that it should be in use by next April, but no indication of which squadron is to receive it first has been given.)

Six Boulton Paul Defiants of No. 264 Squadron in formation in December, 1941. At that time they were operating mostly as night fighters, using pilot-interpreted A.I. equipment.

No. 264 Squadron's first operational month was undoubtedly terrific; and, whether its total of kills is absolutely accurate or not, there is little doubt that the score for the five days—May 27th to May 31st, 1940—was a record. From the unit's archives it appears that five were destroyed on the 27th, six on the 28th, 37 on the 29th and a further nine on the 31st.

The 37 enemy aircraft comprised two Me 109s, fifteen Me 110s, nineteen Ju 87s and one Ju 88. All were destroyed over the Dunkirk area without the loss of a single Defiant out of the 12 operating that day. One Defiant did, however, return home minus both elevators and one aileron.

Much of the success was credited to S/L. Philip Hunter, who evolved the plan to mix the Defiants with conventional single-seat fighters and use with effect the four-gun power-operated turrets when the Luftwaffe made line-astern attacks. But the Germans were quick to learn, and the nine enemy aircraft shot down on May 31st cost seven Defiants.

In the Battle of Britain the squadron operated from Hornchurch, using Manston as a forward landing ground. During a comparatively few hectic days 18 E/A destroyed and a further three damaged were added to the scoreboard. The price paid was 16 Defiants and six crews; this was too high to be continued and the squadron was relegated to a night-fighter role. One of the crews lost included S/L. Hunter.

The night-fighter tactics were entirely on the "cat's eye" principle, until, on September 16th, the first Defiant Mk 2 arrived. This was equipped with pilot-interpreted A.I. Mk 4, which, if all went well, gave a contact at just under one mile. According to the squadron's diary the first contact—the only one in two months—obligingly crashed without a shot being fired at it.

In April 1942 the Defiants gave place to Mk 2 Mosquitoes, which were used for day and night intruding over the Continent, and the following March saw the scoring of the squadron's 100th success. On one occasion at this time the S.A.S.O. of No. 10 Group, A. Cdre Basil (now Sir Basil) Embry flew with the squadron on "Instep" patrols, the most profitable of which was flown on June 20th, 1943, when five Blohm and Voss 138 flying-boats were destroyed and one Bv 222 and two further 138s were damaged in an attack on the base on Lake Biscarosse.

At the time of the invasion of Europe, 264 was operating entirely at night and added a further 22 enemy aircraft to the score; it was the second night fighter unit to be based in the Cherbourg peninsula. For a while, however, it was diverted to England to cope with the V.1 flying bombs, 19 of which were destroyed in nine days. Before the war ended the squadron was operating as far east as Berlin; and before it was disbanded in July 1945 the scoreboard stood at: 148 E/A destroyed, 13 probables and 40 damaged.

No. 264 was re-formed at Church Fenton in November 1945 from No. 135 Squadron and was equipped with Mosquito Mk 30 aircraft. Today it has Armstrong Whitworth N.F.14s and is stationed at Linton-on-Ouse. Last year it won the Ingpen Trophy, awarded to the most proficient all-weather squadron.

An N.F.14 formation "breaks" before making a stream landing during a recent visit to the Gloster Aircraft works at Moreton Valence.

ROTOL

21E SALON INTERNATIONAL DE L'AERONAUTIQUE
AÉROPORT DU BOURGET-DU 10 AU 19 JUIN 1955

AUSTRALIA

GREAT BRITAIN

UNITED STATES

The Canberra —in Service in 5 Air Forces

VENEZUELA

The ENGLISH ELECTRIC Canberra, one of the world's most effective and versatile aircraft, is in service in five Air Forces. Its range and bomb-load may not be published, but it holds the World Record for height, and 12 World Records for speed from point to point—something no other aircraft has ever done before.

The Canberra is in production in three Continents—and still very much under development.

ECUADOR

'ENGLISH ELECTRIC' aircraft

THE CANBERRA MARK 8

NIGHT INTRUDER

One of the latest versions of the Canberra of which details have been released is the Mark 8 Night Intruder—the most versatile of all. It can carry a variety of different armaments—guns, bombs, rockets—and can be used on high or low level operations. Its offset fighter-type cockpit gives to the pilot a superb view, and to the navigator a more spacious compartment. Other versions in production include the Mark 6 bomber, the Mark 7 photographic reconnaissance type and the Mark 4 trainer.

STAND No. 30

PARIS AIR SHOW

THE ENGLISH ELECTRIC COMPANY LIMITED, QUEENS HOUSE, KINGSWAY, LONDON, WC2

The 36th Anniversary of the First Direct Crossing of the Atlantic by Air

THE VICKERS VIMY WAS POWERED BY

ROLLS-ROYCE

EAGLE ENGINES

BRITAIN'S CONTRIBUTION

to a great Paris Salon

Alvis Leonides Major (for helicopter).

Armstrong Siddeley Sapphire 7.

Armstrong Siddeley Double Mamba.

NEVER has a foreign aero show received worthier support from Great Britain than has this year's Paris Salon. The Britannia and Viscount turboprop airliners; the Vulcan delta-wing bomber and Javelin all-weather fighter, of similar wing form; two Canberras; three types of helicopter; the Hunter intercepter; the Gannet and Seamew anti-submarine aircraft; and the ubiquitous Vampire Trainer—all these add up to a showing of unprecedented quality and proportions, though one which promises to be matched by the galaxy of new aero engines. Together with ancillary items, materials and other British offerings, the aircraft and powerplants are now reviewed.

Aero Research (Stand No. 161) The uses of Redux metal-to-metal adhesives for bonding load-bearing aircraft structures will be the theme of this display. These adhesives have been employed over a period of eleven years in nearly 50 different types of aircraft, ranging from airliners to guided missiles, and their "proved durability" will be stressed. Redux is now also supplied in the form of a film, thereby simplifying the bonding of skins to metal honeycomb cores in "sandwich" structures. Practical demonstrations of the technique employed will be given daily on the stand. Also on view will be Araldite epoxy resins for bonding metal aircraft components and for use in the manufacture of de-icing equipment. *Aero Research, Ltd., Duxford, Cambridge.*

Air Service Training (Hawker Siddeley Stand, No. 19) The Aircraft Division of this company will show a one-twelfth-scale model of a high-speed towed target, with a model of a Hawker Hunter, to a similar scale, as the tug. In addition, the Division will display aircraft toilet and toilet servicing equipment as a working unit in the outdoor exhibition. The Training Division will display a map of the world, showing countries from which students have come to A.S.T. for aeronautical instruction. *Air Service Training, Ltd., Hamble, Southampton, Hants.*

Alvis (Stand No. 94) Fixed- and rotary-wing variants of the Leonides and Leonides Major will be on view. The helicopter Major was seen for the first time at Farnborough last year and the standard model is now flying in a Marathon, preparatory to installation in the Handley Page Herald.

The Leonides Major consists, in effect, of fourteen Leonides cylinders, in two rows. For helicopters the engine can be arranged to run with the crankshaft at any angle between horizontal and vertical, and the small overall diameter allows the unit to be mounted in a fuselage without taking up the entire available width, thus permitting a walkway to be provided around the powerplant. A typical fixed-wing Leonides, the 502/5, delivers a maximum take-off power of 570 h.p. at 3,000 r.p.m., and the output of the Leonides Major is 870 h.p. at the same engine speed. *Alvis, Ltd., Holyhead Road, Coventry.*

Armstrong Siddeley (Hawker Siddeley Stand, No. 19) Armstrong Siddeley turbojets will be seen in at least three aircraft in the flying display—the S.O.9000 Trident supersonic fighter-research aircraft, with tip-mounted Vipers; the S.O.4050 Vautour twin-jet bomber, with two Sapphires in underwing nacelles; and the Fairey Gannet (Double Mamba). On the Hawker Siddeley stand will be examples of the Sapphire and Mamba turbojets, and the Snarler rocket motor.

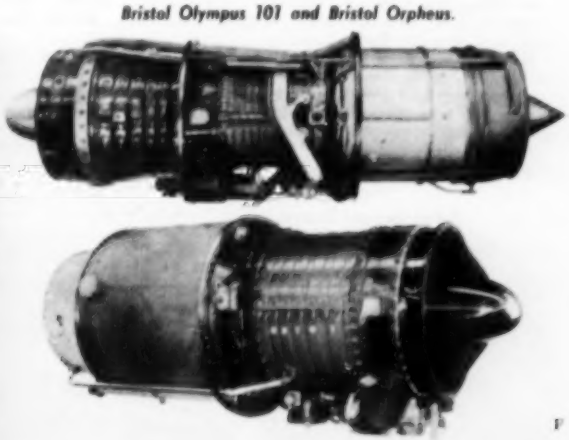
Very extensive deliveries of the Sapphire 6 have been made for the Hawker Hunter, Gloster Javelin and Handley Page Victor, and late last year came the announcement that the Sapphire 7 had been type-tested at a thrust rating of 10,200 lb. The corresponding specific fuel consumption was quoted as 0.885 lb/hr/lb thrust, net dry weight as 2,972 lb, diameter over trunnion mountings as 37.4in, and overall length as 127.6in. Recent ratings for the Double Mamba and Mamba turboprops are 2,920 s.h.p. and 1,480 s.h.p. respectively.

The Snarler rocket motor itself is only a development unit, but is a token of an ambitious Armstrong Siddeley programme, which has already produced the mighty Screamer, intended for installation in ultra-high-altitude supersonic aircraft, either as the sole powerplant or in combination with one or more turbojets. The Screamer has been running on the Bitteswell test beds for a considerable time and has been installed for development flying in a Gloster Meteor. *Armstrong Siddeley Motors Ltd., Parkside, Coventry.*

Armstrong Whitworth (Hawker Siddeley Stand, No. 19) A guided missile test vehicle and a model of the A.W.-developed Meteor N.F.14 night fighter will represent this company on the

Avro Vulcan B.1.

Bristol Olympus 101 and Bristol Orpheus.



BRITAIN'S CONTRIBUTION . . .

stand of the Hawker Siddeley Group. *Sir W. G. Armstrong Whitworth Aircraft, Ltd., Baginton, Nr. Coventry.*

Auster (Agence Aéronautique Legastelois, Stand No. 105) The French agents of the Auster company will feature photographs and particulars of all Auster types, and an Auster representative will be in attendance throughout. *Auster Aircraft, Ltd., Rearsby Aerodrome, Rearsby, Leicester.*

Avro (Hawker Siddeley Stand, No. 19) A Vulcan B.1 delta-wing four-jet bomber (probably a prototype) will fly in the displays on June 18th and 19th. As now in production for the Royal Air Force, the Vulcan is powered by four Bristol Olympus turbojets and, although actual performance data are secret, it is known that cruising at heights above 50,000ft for very long ranges and at very high Mach numbers is normal. Manœuvrability, as will be shown at Le Bourget, is of a quite exceptional order, by virtue of low wing loading, relatively small span and efficient controls. Also on the Hawker Siddeley stand will be examples of Avro "honeycomb" construction, and special emphasis will be placed upon stiffness in bending and endways compressive strength. A model of the Avro Shackleton M.R.3 long-range maritime reconnaissance aircraft (four Rolls-Royce Griffons) will also be displayed. The prototype of this aircraft, which is already in production for the R.A.F. and the South African Air Force, should fly within a few weeks. Another model will depict an Avro Aircraft (Canada) CF-100 long-range all-weather fighter, powered with two Orenda turbojets. *A. V. Roe and Co., Ltd., Greengate, Middleton, Manchester.*

Bristol (Stand No. 22) To avoid interruption of its flight-development programme, the Britannia airliner, one of Bristol's key exhibits, will appear at the show for one day only—Saturday, June 18th—and will return to Bristol immediately. Two helicopters—the Sycamore and the twin-engined, tandem-rotor Type 173—will be present for the entire period, and will participate in the flying display. On the Bristol stand will be four complete engines—the Olympus 101 turbojet (non-sectioned); the Orpheus lightweight medium-thrust turbojet; the Proteus 705 turboprop (sectioned); and the Centaurus 661 piston engine (sectioned). There will be models of the Britannia 300LR, in the colours of B.O.A.C. and El Al Israel Airlines, the Sycamore, 173, Freighter Mk 32 (specifically designed for car-ferry service), and Freighter Mk 31 (the military version of the standard Freighter), with a Sycamore stowed in its hold.

Of the 33 Britannias ordered by B.O.A.C., the first 15 will be Britannia 100s, with Proteus 705 turboprops of 3,780 e.h.p. Subsequent machines will have the Proteus 755 of 4,120 e.h.p. Additionally, B.O.A.C. has ordered eight Britannia 300s, with a fuselage 10ft 3in longer than that of the 100 and with greater payload capacity—these in addition to ten Britannia 300LRs, with additional tankage. El Al Israel Airlines has ordered three Britannia 300LRs, with an option on a further two, and the British Government is ordering three 250LRs (for mixed passenger/cargo work) for trooping. The makers claim as the outstanding feature of the Britannia its all-round flexibility—its economical range of 600-6,000 statute miles, variable arrangement for 60-102 passengers, or freight, or a combination of both, and the possibility of flying economically at any height between 20,000ft and 35,000ft.

Some 70 Sycamore helicopters have been built to date, and substantial orders are still in hand for the British Services. Included in about a hundred twin-engined helicopters ordered for the Services will be a substantial number of Type 191s, primarily for anti-submarine search and attack, but also suitable for air/sea-rescue and transport. Initial production versions will have Alvis Leonides Major engines but gas turbines are under development for future models. The Olympus 101, as displayed, was recently approved for service at an 11,000 lb thrust rating. *The Bristol Aeroplane Co., Ltd., Filton House, Bristol.*

C.T. (London) Ltd. (Stand No. 47) Products of five British manufacturers will be featured on this stand. They are B.S.A., Ltd. (Precision Castings Division), Sir George Godfrey and Partners, Ltd., Martin-Baker Aircraft Co., Ltd., Mechanism, Ltd., and Murphy Radio, Ltd.

B.S.A. will show precision castings manufactured by the investment, or lost-wax, process, and used for components of turbojets, gun and generator parts, etc. These castings are manufactured to very close tolerances in steels to British and American specifications.

Sir George Godfrey and Partners will show cold-air units (CA-7, ACRE-9, TF-10 and TF-5), a Type 15 cabin supercharger and Type WE-15 water extractor, and a ventilated suit, the last-named being an item of particular note.

Bristol Britannia 100.

The Martin-Baker Mk IV lightweight ejection seat combines full automatic facilities with the very low installed weight of 60 lb, and it is said that the telescopic ejection gun, of 80 ft/sec velocity and with very low peak acceleration, will carry the occupant clear of the structure of any contemporary or projected aircraft.

Mechanism, Ltd., will have their Machmeters, a contacting Machmeter and a transmitting Machmeter, an air-speed indicator Type M.1745, a transmitting air-speed indicator, a helicopter low-range air-speed indicator, a fatigue meter, a transmitting accelerometer, a Type M.1758 strain range transmitter, and a Type M.1765 combined Machmeter and air-speed indicator.

The Murphy display will comprise a D.M.E. Type 1 "Rebecca 7" and Type 6 (civil version), Type MR.175 test equipment, R.B. 110 radar beacon, Type MR.255 beacon monitor, Type MR.80 and MR.100 V.H.F. equipment, Type MR.69A passenger announcement equipment, and Type VR.61B voltage regulator. *C.T. (London) Ltd., 75 Victoria Street, London, S.W.1.*

de Havilland (Stand No. 7) In the flying display de Havilland hope to show a Vampire Trainer, as adopted by eighteen national air forces. This is a particularly easy machine to fly, and can be introduced into the training syllabus at a very early stage and yet cover all the advanced techniques of the modern operational fighter. The Goblin turbojet is, of course, standard.

The Gipsy Major Series 200 is a new addition to the range of Gipsy engines. It is still under development but already has behind it a large number of hours' flying in the Saunders-Roe Skeeter Mk 6 helicopter. A four-cylinder unit, it develops 200 b.h.p., is unsupercharged and employs fuel injection. Especially interesting are its possibilities in the light helicopter field.

The Super Sprite is the first liquid-fuel rocket to pass a Ministry of Supply Type Approval test. It employs hydrogen peroxide as an oxidant, with a solid catalyst, and uses kerosine fuel injection. Self-contained, it is jettisonable after take-off when installed in a special pack. Total impulse is 120,000 lb-sec, maximum thrust 4,200 lb, duration 40 sec, and net dry engine weight 600 lb. *The de Havilland Aircraft Co., Ltd., Hatfield, Herts.*

Dowty (Stand No. 48) Three companies—Dowty Equipment, Ltd., Dowty Fuel Systems, Ltd., and Dowty Seals, Ltd.—will be exhibiting. Dowty Equipment, Ltd., will show main undercarriages for the Hawker Hunter, Gloster Javelin and Fokker S.14, and a Hunter nose undercarriage, each unit embodying Liquid Spring shock absorbers. Additionally, there will be hydraulic components, including the Vardel 4,000 lb/sq in hydraulic pump—the only pump of its kind approved for use with water-based fluid at this pressure—and electrical components. The latter will comprise undercarriage indicators of the miniature lamp and magnetic "eyeball" type; the new three-position indicator; and push-button, lever, drum, commutator and Dowmic sequence switches. Dowty Fuel Systems, Ltd., will show spill-flow burners, the complete control and circulating unit and other components of the Dowty gas-turbine fuel system (as used on the D.H. Venom), together with the ENG.129 Sapphire fuel pump. The contribution of Dowty Seals, Ltd., will be a complete range of all types of sealing media; O-, U-, square- and wiper-section ring seals, and grommets in natural, synthetic and silicone rubber; leak-proof washers, lock washers and bolts; mouldings; bonded details and Fluon fabrications. *Dowty Equipment, Ltd., Cheltenham, Glos.*

English Electric (Aircraft Division) (Stand No. 30) In the flying display on June 18th and 19th will be a Canberra B.8 night intruder (which it is not planned to bring to the static park before or after the flying), and in the static display outside the main hall a Canberra T.4 trainer, this being exhibited for the

Fairey Gannets in service with the Royal Navy.

Hawker Hunters in service with the R.A.F.

Over seas oversea

in the line of duty

Fairey Gannets, now in H.M.S. *Eagle*, will shortly be operating in training exercises over Mediterranean waters, where British sea power has so frequently been displayed in the past.

The Gannets thus take up another of their destined roles—guardians of the Fleet and the merchant ships against submarine attack. From carrier deck or shore base the "eyes of the Fleet" are flown confidently—the Double Mamba engine installed exclusively in this aircraft gives double assurance of operational efficiency and safety.

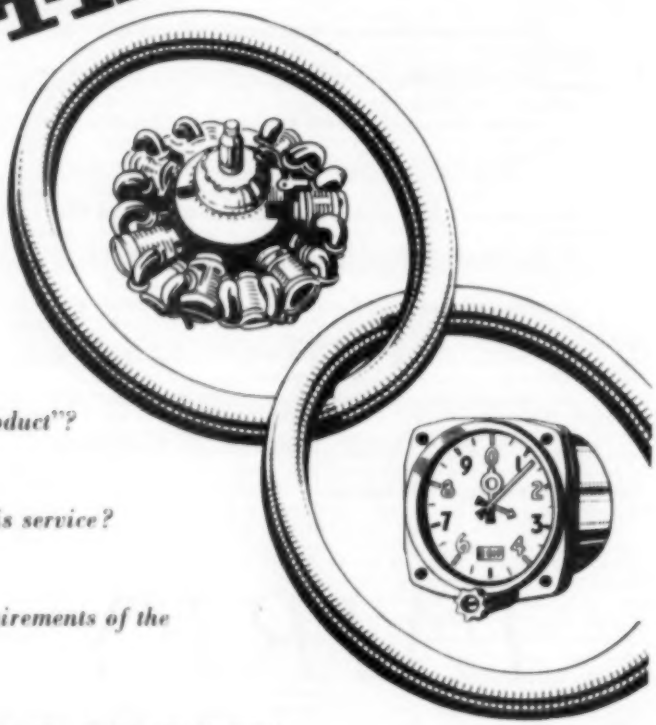
FAIREY

GANNET

THE FAIREY AVIATION COMPANY LIMITED · HAYES · MIDDLESEX

ALL HAVE BEEN OVERHAULED BY FIELD'S

FIND THE LINK



PANEL

Q. *Does this concern all aspects of Aviation Repair?*

A. YES

Q. *Is this a service rather than an "end product"?*

A. YES

Q. *Do many operators take advantage of this service?*

A. YES

Q. *Have they all been overhauled to the requirements of the A.R.B. or A.I.D.?*

A. YES

Q. *Have they all been overhauled to a high standard of "QUALITY AND INSPECTION"?*

A. YES

Q. *Then all must have been overhauled by "FIELD'S"?*

A. CORRECT

(ONE TO THE PANEL)

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Comprehensive Aircraft Service

Supply · Overhaul · Repair

Aircraft · Engines · Propellers · Components

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The New Comet

ROLLS-ROYCE AVON JET ENGINES

Sheer speed
Sheer luxury

Five hundred miles an hour in an atmosphere of incomparable comfort, with a smoothness and quietude hitherto unexampled.

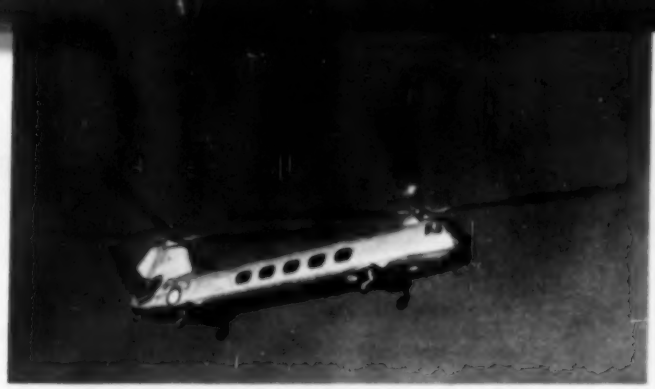
Speed shortens the journey and comfort makes it seem shorter still. One arrives without the feeling of having travelled.

The Comet will surpass every other aircraft for world travel

Basic performance of the new Comet 4: Cruising speed 500 miles an hour, with 58 first-class passengers (alternative arrangement seats 76 tourist passengers) on stage lengths of 2,870 miles, with full reserves, against a 50 m.p.h. headwind.

The superior vehicle masters the route

DE HAVILLAND OF GREAT BRITAIN



Bristol 173.

Bristol 171.

BRITAIN'S CONTRIBUTION . . .

duration of the show. On the stand the Aircraft Division will be represented by two models of these aircraft, in addition to five smaller model Canberras in the livery of the five Canberra-equipped air forces—the R.A.F., R.A.A.F., U.S.A.F., and the Venezuelan and Ecuadorean Air Forces. *English Electric Co., Ltd., Marconi House, Strand, London, W.C.2.*

English Electric (Guided Weapons Division) (Stand No. 30) There will be two identical guided-weapon exhibits opposite the side entrances to the stand of the Aircraft Division. Each will carry a 6ft model of an English Electric test missile, and on the supporting structure will be photographs of test firings and of the Division's activities in England and at Woomera, Australia.

English Electric (Aircraft Equipment Division) (Stand No. 30) The star exhibit by this Division will be the English Electric Sundstrand constant-speed alternator drive, of which there will be a cut-away model and an actual drive unit connected to a 40kVA alternator. The A.C. equipment display will consist of an alternator and A.C. motors; moreover, there will be a wide range of D.C. equipment, including actuators, motors, generators, transformers, inverters, blowers and control gear. A fuse-gear panel from Liverpool will also be included.

Fairey (Stand No. 61) Three Gannets—two standard production A.S.1 anti-submarine aircraft and one Gannet T.2 dual-control trainer—will take part in the flying displays on June 18th and 19th, having flown from Ford to Le Bourget on June 17th. After their Sunday display they will not land again at Le Bourget but will return direct to England.

In the static exhibition Fairey Aviation and Avions Fairey are jointly participating. There will be large-scale models of the Gannet, Rotodyne, the new ultra-light helicopter and the F.D.2 delta-wing supersonic research aircraft. Additionally, there will be an extensive range of power controls and—something unique in its way—a collection of eight paintings of post-war aircraft. Fairey Aviation take pride that they now possess in the form of oil paintings records of all their aircraft from the Battle and Swordfish onwards. *The Fairey Aviation Co., Ltd., Hayes, Middx.*

Gloster (Hawker Siddeley Stand, No. 19) Permission has been received from the Ministry of Supply for a standard-production Gloster Javelin FAW.1 all-weather fighter to fly in the displays at Le Bourget. On the Hawker Siddeley stand will be a one-twelfth scale model of the Javelin, together with a sectioned example of the Gloster-Longford fuel proportioning valve and a large working model of the valve. *Gloster Aircraft Co., Ltd., Hucclecote, Glos.*

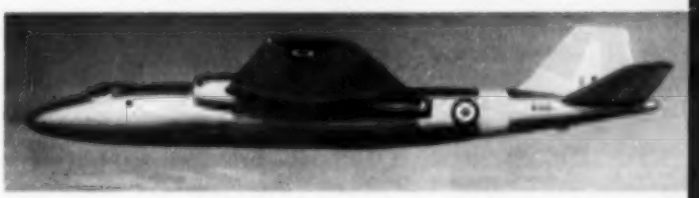
Handley Page (Stand No. 66) The main emphasis on the H.P. stand will be the fitness of the Herald transport "for the world's workaday routes" and its performance and operational qualities. Recorded commentaries, models and photographs will be used to this end. A high-wing monoplane of 34,000 lb all-up weight, the Herald will carry a maximum of 44 passengers, or more than 4½ tons of freight, or combinations of both. Powered with four Alvis Leonides Major piston engines, it will operate over short to medium ranges, carrying maximum payload for 350 miles or 3¼ tons for 1,000 miles. It will take off with full payload from a 1,000-yd grass strip at 5,000ft under tropical conditions. Direct operating cost is quoted as less than 1½d per passenger mile or 1s 3d per ton mile. The first prototype is now approaching completion and overseas orders have already been placed for 29 Heralds.

Additionally, there will be models and photographs of the Victor crescent-wing bomber, powered with four Armstrong Siddeley Sapphire turbojets. *Handley Page, Ltd., Cricklewood, London, N.W.2.*

Hawker Siddeley Group (Stand No. 19). Specific exhibits by member companies of this Group are dealt with separately under the headings *Air Service Training, Armstrong Siddeley, Armstrong Whitworth, Avro, Gloster* and *Hawker. Hawker Siddeley Group, Ltd., 18 St. James's Square, London, S.W.1.*

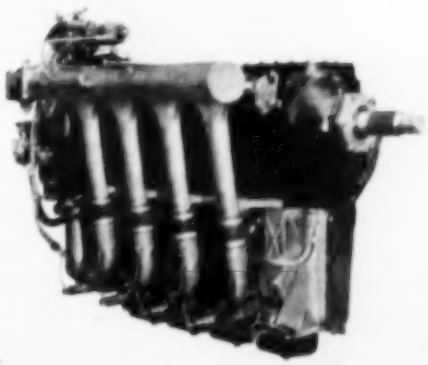
Hawker (Hawker Siddeley Stand, No. 19) In the flying display will be a Hawker Hunter F.4—a production machine of the type already in service with the Royal Air Force. Hunter production is under way at an impressive rate in Great Britain, and the first machine to a combined NATO and Dutch Government order recently flew from Schiphol. In all, NATO orders call for 112 Hunters to be built by Fokker in Holland and by SABCA and Avions Fairey in Belgium. The Dutch Government has ordered a further 156 Hunters from Fokker. The Hunter (which has been adopted also by Denmark and Sweden) is not only an intercepter fighter of quite outstanding merit and possessing the exceptionally heavy armament of four 30 mm Aden guns, but it is being developed also as a ground-support aircraft. A trainer variant, with side-by-side seating, is also under development. The very quick "turn-round" times being achieved by Hunters are largely accounted for by the gun pack, embodying the guns and the ammunition boxes. This pack forms part of the bottom surface of the front fuselage, and on landing the whole assembly is removed and a new, fully loaded, pack immediately raised into position by means of a special trolley. The used pack is then removed and reloaded in the armoury ready for the next sortie. A Hunter gun pack will be a key exhibit on the Hawker Siddeley Stand. The Sea Hawk carrier-borne fighter/bomber will be represented by a model. *Hawker Aircraft, Ltd., Canbury Park Road, Kingston-on-Thames, Surrey.*

English Electric Canberra B.8.



English Electric Canberra T.4.

High Duty Alloys (Stand No. 59) The theme of the High Duty display will be the use of Hiduminium aluminium alloys for high strength at elevated temperatures and the main features will be examples of forgings in Hiduminium 100, which material is now beyond the development stage. It has many characteristics claimed to offer great advantages over existing alloys, two of these being its recovery after repeated soaking at high temperatures and its resistance to corrosion, which is equivalent to that of pure aluminium. Other exhibits will include Hiduminium RR.88 as an impeller forging, RR.77 as extrusions, and RR.350 as a sand casting. Finally there will be compressor blades, and castings and forgings produced in other Hiduminium and Magnuminium alloys. *High Duty Alloys, Ltd., Slough, Bucks.*



D.H. Gipsy Major, Series 200.

de Havilland Super Sprite.

Gloster Javelin FAW.1.

BRITAIN'S CONTRIBUTION . . .

Hobson (Stand No. 55) Of special interest will be a working model of the Hobson powered flying control Type 163, designed to operate the tailplane of the Gloster Javelin and embodying a screw-type jack powered by a duplicated hydraulic system. A built-in collapsible-link device affords protection against a "runaway" condition due to control-valve seizure. Additionally, there will be models of the Mk 6, Mk 7 and Type 145 powered flying controls and the Hobson feel simulator. The last-named employs hydraulic power to apply artificial forces to the control column. Other exhibits include the Hobson powered flying controls Types 190, 194, 157, Mk 8, 189 and 147—the 147 being designed to operate the elevator of a heavy bomber. Feel simulator controls will be of Type 175 (Mach-number corrected), Type 183 and Type 195, and injection carburettors of the Type A.R.1 and Type 122 ALM.6. Other items will be the fuel pump Type 123 ALM.6, the master-control injection carburettor Type B.C.19M, injection carburettor Type B.I/B.H.11, carburettor Type A.I./55-J (as fitted on the French Potez 6D-00 engine), and carburettor Type A.I./55-E. The company also intend to have their speed-governing fuel control unit Type 100, anti-g and fuel cut-off valve Type 124, and booster pump Type 1400. *H. M. Hobson, Ltd., Fordhouses, Wolverhampton, Staffs.*

Jablo Plastics Industries (Stand No. 209B) This company will show lightweight plastics for refrigeration and sound insulation, anti-vibration measures, buoyancy, hollow-structure fillers, and upholstery. Other items will be lightweight insulated containers for perishable goods in air transit, and lightweight panels for partitions. Jabroc (laminated wood) will be shown in the form of tools, assembly jigs and templates. *Jablo Plastics Industries, Ltd., Mill Lane, Waddon, Croydon, Surrey.*

Lodge Plugs (Stand No. 31) Sintox insulated and screened aircraft sparking plugs for British, American and other engines will be on view, together with Lodge igniters for jet engines (including de Havilland and Rolls-Royce types) and Lodge specialized servicing equipment for aircraft plugs—the spark and leak tester, hot leak tester and chemical cleaner. *Lodge Plugs, Ltd., Rugby.*

Lucas and Rotax (Stand No. 111) A Lucas reheat turbo-pump, driven by a two-stage air turbine turning at 25,000 r.p.m. and drawing about 0.69 lb of compressor-bleed air per second, will be shown in sectioned form. There will be a range-temperature control unit, hydro mechanical governors, and a turboprop jet-pipe temperature limiter in which long quartz rods, with a large sensitive area, are housed in a fairing extending across the jet-pipe. The Lucas range of de-icing and space heating equipment will be represented, as will a variety of high-temperature bellows in various materials, including Nimonic alloys.

Rotax will show their fuel/air turbine starter which, being split up into motor and remote control units, does not require a long nose bullet. Other recent fuel/air starter equipment will include the four-stage air compressor, with air cooling, and delivering at 3,000 lb/sq in to a glass-fibre air bottle. Lastly there will be pre-fabricated ignition harness for gas turbines. *Joseph Lucas (Gas Turbine Equipment), Ltd.*, and *Rotax, Ltd., Chandos Road, London, N.W.10.*

Marconi (Stand No. 30) A big feature of the Marconi section of the English Electric stand will be a demonstration of the A.D.307 multi-channel self-tuning HF transmitter/receiver, primarily designed for pilot-operated service. Two hundred crystal-controlled channels are available and entire automatic frequency changing with self-tuning circuits is provided. The set will be raised off the exhibition table and will have mirrors beneath so that the working of all parts can be seen. An aircraft set which will be on public view for the first time is the AD.704 VOR/localizer/communication receiver, with frequency coverage of 108-136 Mc/s, which forms part of the new AD.704/706/708 receiver combination for VOR/ILS, the other units being the glide slope and marker receivers. Three other Marconi aircraft installations will be the AD.115 VHF multi-channel communication transmitter/receiver; the AD.7092D automatic direction finder (radio compass); and the AD.401 intercommunication equipment. Ground installations will be a console unit of the AD.200 VHF automatic direction finder (working), and the aerial exciter unit of the AD.503 VOR equipment. Finally there will be models of a VOR beacon and the new S.232 airfield radar.

Marconi's Wireless Telegraph Co., Ltd., Marconi House, Chelmsford, Essex.

Napier (Stand No. 30) Key exhibits will be the Eland turboprop and the Oryx turbo-gas generator, as now under development for helicopters such as the Hunting Percival P.74. On demonstration will be the Napier contour de-icing equipment, on the spinner of the Eland. The Eland is a single-shaft turboprop with a ten-stage compressor, six combustion chambers and three-stage turbine. Diameter is 36.1in, length 104.5in, dry weight 1,575 lb, and maximum power, 3,007 e.s.h.p. at 12,500 r.p.m. with a specific fuel consumption of 0.624 lb/hr/e.s.h.p. A typical cruising s.f.c. is 0.480 lb/hr/e.s.h.p. at 35,000ft.

The Oryx has been developed by the Napier company to a Ministry of Supply contract to supply a steady flow of hot gas, at a relatively low pressure, to a power-producing section remote from the unit itself. The gas could be fed to a power turbine driving propulsive airscrews or could be ducted through the hollow blades of a helicopter rotor to feed propulsive jets at the blade tips. The axial compressor employed is possibly the smallest ever used in an aero engine. Maximum diameter of the engine is 19½in, dry weight 495 lb, and maximum sea level output 750 gas horse-power, with a specific fuel consumption of 0.68 lb/hr/g.h.p. *D. Napier and Son, Ltd., 211, The Vale, Acton, London, W.3.*

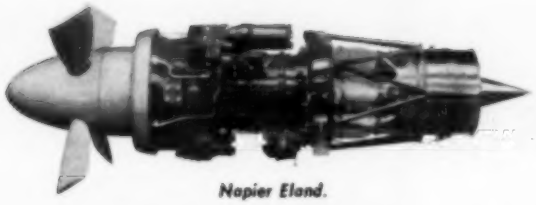
Normalair (Stand No. 27) Centrepiece of the Normalair stand will be a three-dimensional scale model of a representative air-conditioning and cabin pressurization system for a large passenger aircraft. The many units also on display will be grouped as: equipment in the Vickers Viscount; equipment in British aircraft ordered for NATO; equipment in American aircraft in service with NATO; new developments in cabin atmosphere control equipment; and oxygen equipment. Especially noteworthy will be the automatic flow controller for civil transport aircraft, and a butterfly flow-control valve. Among air-conditioning items will be two entirely new mixing valves, together with a venturi humidifier, which permits a very high degree of water absorption, embodies no pumps and requires no head of water for efficient working. Among new items of oxygen equipment will be the Type NF oxygen mask. *Normalair, Ltd., Yeovil, Somerset.*

Plessey International (Stand No. 36) Newly developed items to be displayed will include a liquid-fuel starter for gas turbines, a high frequency ignition system, windscreen de-icing controller, flasher units, crimping tools, magnetic indicators, electric tachometer, actuators, pumps, plugs, sockets and pre-formed wiring and HF and VHF equipment for airborne and ground operation. Two versions of the liquid-fuel starter will be shown, both using iso-propyl nitrates; the larger is now starting "the largest turbojet engines projected to date." Starting is achieved within the voltage range 16-26v from the aircraft's batteries. The cost per start is 4s for present turbojets and up to 7s for the larger types under development; the unit weighs 95 lb. Within ten seconds from pressing the "on" button the turbojet is at idling speed. *Plessey International Ltd., Vicarage Lane, Ilford, Essex.*

Rolls-Royce (Stand No. 24) Although Rolls-Royce will not be represented on their own behalf in the flying display, a number of machines will be powered with Rolls-Royce engines. Notable among these will be the supersonic Mystère, fitted with an Avon supplied from Derby, though Hispano-Suiza were responsible for the installation.

On the Rolls-Royce stand will be examples of the Avon and Soar turbojets and a sectioned Dart turboprop. The Avon will be representative of a 10,000 lb thrust unit, weighing 2,890 lb, and the Soar will be of the RSr.2 type, delivering 1,810 lb thrust for 275 lb weight. Quoted figures for the Dart are 1,600 b.h.p. for 1,110 lb weight. Particular interest is likely to be attracted by the Soar, for this unit has not hitherto been shown outside England. For development flying a Meteor has been adapted to carry a Soar at each wing tip. The Soar is already in production for a wide range of applications, and is particularly significant in view of Rolls-Royce's known activities in the field of jet lift. *Rolls-Royce, Ltd., Derby.*

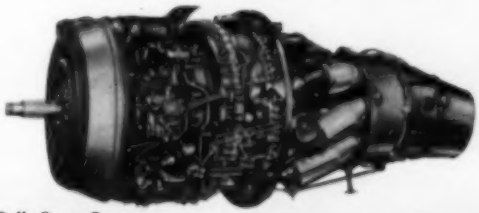
Rotol (Stand No. 43) Outstanding among the Rotol exhibits will be an airscrew specifically designed for the Viscount 800, powered by the 1,650 h.p. Rolls-Royce Dart 510 (or RDa.6) turboprops. It embodies the following new features: square-tipped, high-activity blades; steel sheet protection for de-icing overshoes; third oil-line operation of the flight fine-pitch lock; emergency electro-hydraulic flight fine-pitch stop. Nearby will be associated equipment—the controller unit, feathering pump, synchronizer alternator, corrector motor and accessory gear-box. A typical air turbine will also be shown, without its associated gear-box and accessories, in order to demonstrate the basic driving mechanism. Of 7¼ inches diameter, it is capable of developing 100 h.p. A complete ram-air turbine, designed to provide emergency power in the event of main engine failure, will also be on view. The fuel-flow proportioner exhibited will be a two-cell type actuated by the action of the fuel passing through it, and the accessory gearbox will be for an Armstrong Siddeley



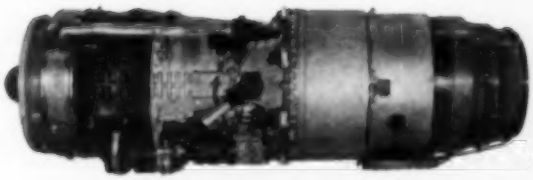
Napier Eland.

Rolls-Royce Soar.

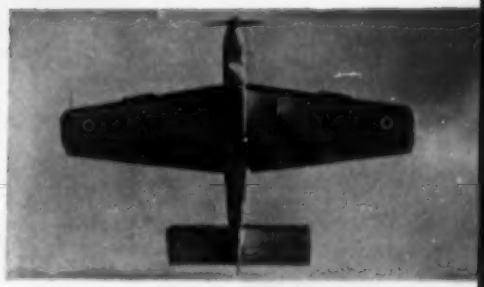
Napier Oryx.



Rolls-Royce Dart.



Rolls-Royce Avon 521.



Short Seamew A.S.1.

Sapphire. A 9.5 h.p. 208v A.C. motor, designed and manufactured by Rotol, will be shown coupled to a British Messier hydraulic pump Type 4814 Mk 11. British Messier undercarriage units on exhibition will be those for the Folland Gnat and Short Seamew. A model will demonstrate powered flying controls. *Rotol, Ltd., Cheltenham Road, Gloucester.*

Saunders-Roe This company will have no stand in the static exhibition but have entered the Skeeter Mk 6 light helicopter for demonstration and display in the open air. The Skeeter 6 is powered by a de Havilland Gipsy Major 30 engine, weighs 2,200 lb all-up, and has side-by-side seating with dual control. Duties coming within its scope are listed as: personal transport; training; air mail; crop spraying; traffic control; survey work; photographic reconnaissance; airborne inspection of power- and pipe-lines; forest fire patrol; radar calibration; and air observation. *Saunders-Roe, Ltd., (Helicopter Division), Osborne, East Cowes, Isle of Wight.*

Short and Harland (Stand No. 17) A Seamew A.S.1 light anti-submarine aircraft, as now in production for the Royal Air Force and the Royal Navy, will take part in the flying display and will be featured on the company's stand. This aircraft is notable for its cheapness, lightness, simplicity and easy handling. It is powered with an Armstrong Siddeley Mamba and the undercarriage is fixed. No gun armament is incorporated in the anti-submarine version, but this could be supplied were the machine to be used for second class warfare, e.g., tribal control. As an anti-submarine machine the Seamew can carry one heavy, and still-secret, store in the bomb bay in addition to four sonobuoys, and four rocket projectiles and eight marine markers under the wings. Another representative load is two depth charges and five sonobuoys in the bomb bay, and four R.P.s and eight marine markers beneath the wings.

Additionally, Short's electronic analogue computer will be on view. *Short Brothers and Harland, Ltd., Queen's Island, Belfast, N. Ireland.*

Standard Telephones and Cables (Stand No. 57B) An entirely new piece of equipment, exhibited for the first time, will be the SR.32, an airborne navigational and landing aid, receiving VOR, ILS and marker-beacon information. It is capable of receiving the following frequencies: (a) any one of 100 channels in the I.C.A.O. navigational frequency band 108-117.9 Mc/s; (b) any 20 spot frequencies in the I.C.A.O. navigational frequency band 329.6-335 Mc/s allocated for the glide path portion of the ILS system; (c) 75 Mc/s, the frequency allocated for the marker beacon. The SR.32 comprises three main units—the localizer/VOR receiver, the glide path and marker receiver, and the power supply—and a control unit. Making its first appearance at Paris will be the STR.20 560/623-channel VHF airborne communication equipment, specifically designed for military use as a successor to the STR.9X, of which more than 20,000 are in service with some 23 of the world's air forces. Other items on view will be the STR.18C. 100-channel pilot-operated high-power HF RT airborne communication equipment, STR.18B-2 24-channel pilot-operated high-power HF RT airborne communication equipment, STR.12D 140-channel VHF airborne communication equipment, STR.30B frequency modulated radio altimeter, A.2208 miniature display unit for cathode-ray direction finders, and radio interference suppressors. *Standard Telephones and Cables, Ltd., 10 Essex Street, Strand, London, W.C.2.*

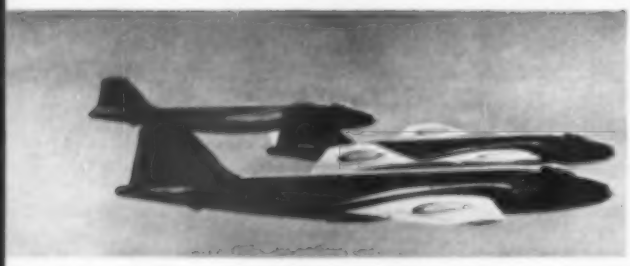
Thermionic Products (Stand No. 102) Together with their French licensees, Compagnie des Compteurs, of Montrouge, this company will show multi-channel airport recorders Mks 2 and 6 and a range of quartz crystal units manufactured by their associate company, the Brush Crystal Co. The French licensees will show a multi-channel recorder made under licence in France, and there will be R.A.N.A. radio navigation equipment and a cloud telemetering system. *Thermionic Products, Ltd., Hythe, Southampton.*

Vickers-Armstrongs (Stand No. 64) There is a possibility that an Air France Viscount will make an appearance, but other than this, Vickers-Armstrongs aircraft will be represented only by models—of the Valiant four-Avon bomber, the Viscount, the V-1000 four-Conway transport and the Type 525 fighter. The last-named is the precursor of the N.113 twin-Avon fighter for the Royal Navy. *Vickers-Armstrongs, Ltd., Vickers House, Broadway, London, S.W.1.*

Henry Wiggin (Stand No. 25) A variety of gas turbine components made in the Nimonic series of alloys by French and British manufacturers will be shown by this company. The components will include turbine discs and blades, flame tubes, rings and an afterburner assembly. Also on display will be heat-insulating blankets encased in Inconel foil, and an air intake provided with an electrothermal de-icing system, embodying Brightray S and Ferry electrical resistance alloys. For the first time the company's technical periodical *Wiggin Nickel Alloys*, will be available in French. *Henry Wiggin and Co., Ltd., Wiggin Street, Birmingham 16.*

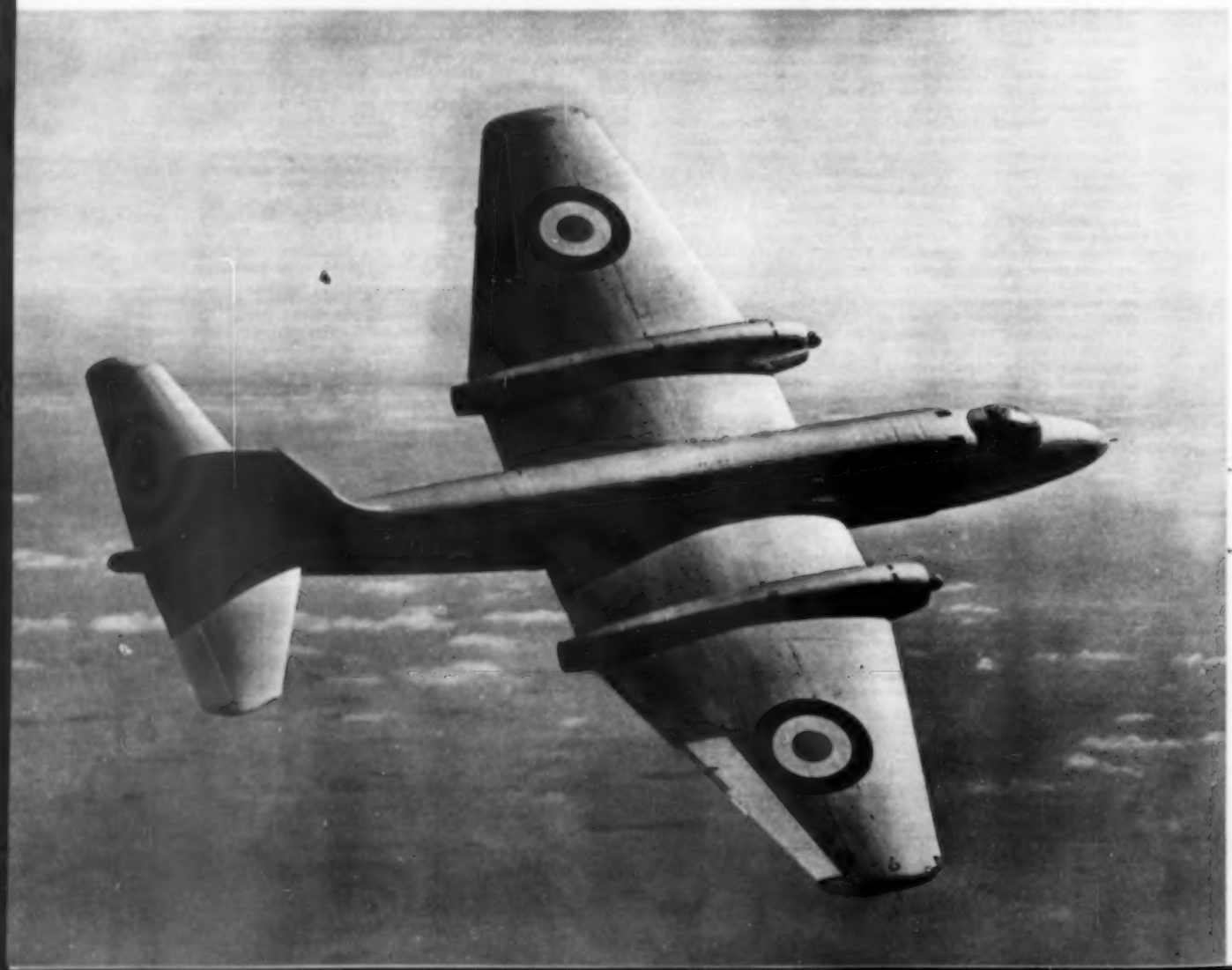
Saunders-Roe Skeeter.

Vickers-Armstrongs Viscount.

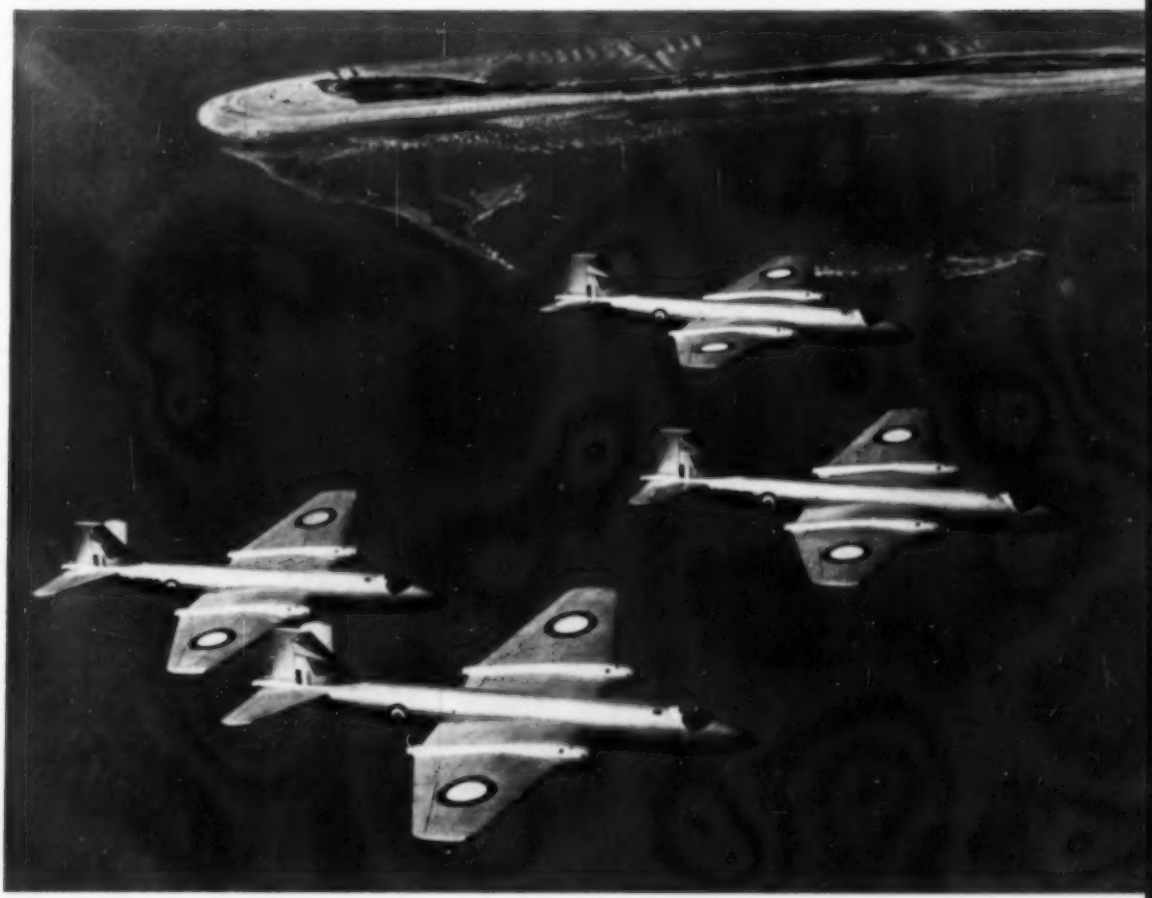


SILVER IN THE SUN

LIKE the exquisitely wrought presentation models which grace the officers' messes of the Royal Air Force are these Canberras of Bomber Command. The four aircraft (they are B.6 light bombers, powered by two Rolls-Royce Avons) are drawn from Nos. 109 and 139 Squadrons, the pilots of the "139" machines being S/L. A. Ashworth, D.S.O., D.F.C., A.F.C., and F/O. H. M. North, and of "109" F/O. B. R. Davies and P/O. M. J. Hawkins. Taken from a Gloster Meteor T.7 flown by F/L. R. G. M. Burton, the pictures are, we think, especially notable for the variety and subtlety of their lighting. In the large view below, for instance, the "up" aileron has been caught by the light, and the strong cast-shadow of the fuselage accentuates the section of the mainplane. Prominent in some views is the long di-electric fairing attached low on the starboard side of the forward fuselage. This is something entirely new and is officially admitted to be a radar aerial, though its purpose may not be specified. In the last view on the opposite page the Canberras are crossing the Lincolnshire coast just south of Grimsby and nearby Spurn Head can be seen in the photograph above.



"FLIGHT" PHOTOGRAPHS BY L. W. McLAREN



Introduction to AIR FREIGHT

Part 2: Britain's Bid on the Atlantic Route

IT was emphasized in the first part of this article (May 20th, 1955) that the carriage of goods on the scheduled air services of the world remains supplementary to the carriage of passengers, and that the bulk of cargo traffic flows *via* "combination" rather than all-freight aircraft. The North Atlantic route is by no means an exception to this rule. Thirteen of the 14 I.A.T.A. airlines flying between Europe and North America carry freight as make-weight on their passenger aircraft, but only five operate all-freight services; these carriers and their services are tabulated below:

Carrier	Type of a/c	Terminals	No. of round trips weekly
Airwork	DC—4	Frankfurt, London, New York	2
—	DC—4A	London, New York	1
K.L.M.	DC—4	Amsterdam, New York ...	2
P.A.A.	DC—4	Frankfurt, New York	1
—	DC—4A	Frankfurt, New York	2
Swissair	DC—4	Zurich, New York	1
T.W.A.	DC—4	Paris, New York	1
			10

Transatlantic freight traffic has grown at a steady but not spectacular rate throughout the post-war years. The average annual increase since 1950 has been about 1,000 tons. Last year the total lift by I.A.T.A. airlines was probably in the region of 10,000 tons, with Seaboard and Western Airlines—who operate frequently but on a non-scheduled basis—contributing perhaps 2,000 tons more. The introduction of North Atlantic tourist services in 1951 generated a good deal of new passenger business, but there was no corresponding increase in freight traffic, a major reason being that the airliner converted for tourist work generally has less freight capacity than in its original, first-class form.

At some risk of over-simplification, one might say that there are two philosophies behind the introduction of all-freight services. In the first case, an operator of passenger services may find that combination aircraft cannot conveniently carry certain types of loads—*e.g.*, large pieces of machinery or live-stock. When such loads present themselves with reasonable frequency it becomes preferable to carry them on regular flights rather than on a charter basis. Having thus acquired an incentive to operate all-freight aircraft, the airline will intensify its cargo-sales effort to ensure paying loads.

The second case is that of the operator primarily interested in freight for its own sake. Such carriers are, of course, in a minority the world over; on the North Atlantic, Airwork and Seaboard and Western Airlines are the only examples. The difference between these two companies is that Airwork's freighters fly to a published schedule, whereas Seaboard lack C.A.B. certification as a regular carrier (though they have repeatedly sought this status over the past eight years) and cannot advertise their services. As an irregular carrier, Seaboard can charge rates above or below those agreed on, through I.A.T.A., by the scheduled airlines, Airwork included.

The North Atlantic is the most important inter-continental trade route in the world, and there is no need to stress that it offers the air freight operator a great volume of traffic potential. So great is the potential that a ten-fold increase in the present flow of airborne freight would leave the bulk of over-water movement virtually untapped. The objective of the Atlantic air carrier is two-fold: to skim the cream from present seaborne traffic (no one is bold enough to predict aerial movement in bulk of basic mineral or vegetable products), and to develop new forms of transoceanic traffic owing their very existence to air transport.

No two experts agree on the precise volume of transatlantic traffic which aircraft can be expected to attract during the next decade or so. Estimates ranging from 32,000 to 80,000 tons annually were submitted when, in 1952, six American carriers applied to the C.A.B. for a transatlantic freight licence. What is certain, however, is that the depth of cream skimmed from surface freighters will depend on two factors—the quality of transatlantic air freight and its cost.

Air freight has already made it possible for consignments dispatched in New York one day to be in London the next morning (or vice versa). Pressurization ensures that livestock or perishables are delivered in perfect condition, and few shipments require the heavy packing usually associated with ocean freight. The average shipper's business is not geared to a faster rate of delivery, and in most other respects he has reason to be well satisfied with the *quality* of service offered by air freight. He might welcome an increase in all-freight frequencies, as well as some simplification of Customs procedures, but these aspects present no technical problems.

The carrier, no less than his customers, is anxious to bring down the *cost* of air freight to the point where "bread-and-butter" consignments exceed the high-value and emergency shipments which make up the bulk of today's traffic. At present the biggest barriers to progress in this direction are formed by the characteristics of the route itself. The shortest (and the most important) of the North Atlantic traffic routes is that between London and New York—a distance of nearly 3,500 statute miles, which is too great for existing freight aircraft to make regular non-stop crossings in both directions without severe restrictions on payload. Stops made solely for the purpose of refuelling naturally increase operating costs beyond the low figures achieved on, say, the United States trans-continental routes.

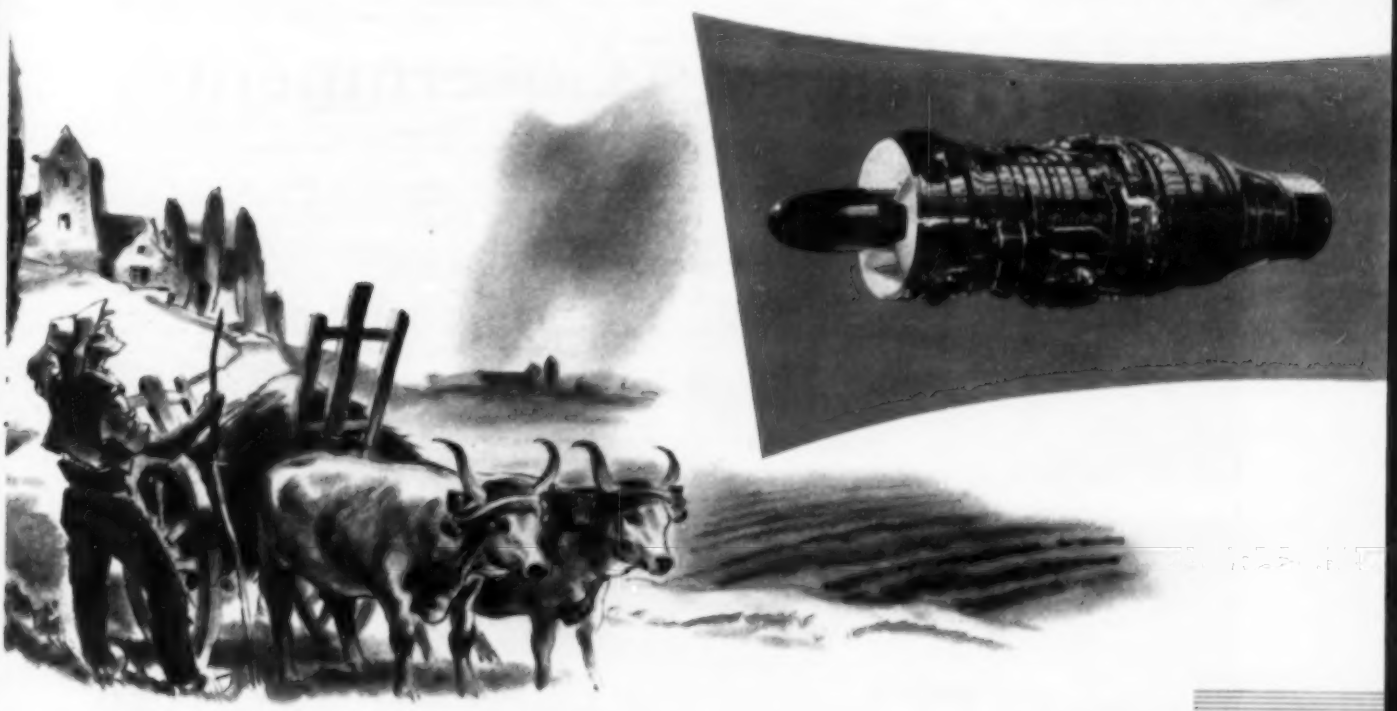
The aircraft chosen for future transatlantic freighting will therefore require extreme range, a high payload (most operators would probably quote 15 tons as a minimum) and sufficient speed to guarantee overnight deliveries in either direction and to minimize the effects of the strong westerlies which blow throughout the winter months. Its fuselage would be pressurized and, preferably, would feature a large, ramp-type rear door. One need spend only a few moments watching the turn-round of a conventional freighter to appreciate the savings, in man hours and cost of handling devices, afforded by ground level loading.

But whatever the future may bring in the way of speedier, more capacious and farther-ranging freighters, our immediate concern here is with the already considerable progress made with existing equipment in the development of the transatlantic air freight business.

Scheduled all-freight services between Europe and America were first operated by P.A.A. and T.W.A. in 1947, both carriers operating low-frequency DC-4 services to supplement the cargo space available on their passenger flights. Though undoubtedly the best equipment then available, the DC-4 offers only "marginal economic characteristics" as a transatlantic freighter, and the success of these initial operations depended on the attainment of high load factors. In the event, results were not particularly encouraging and in 1950 PanAm suspended their services. Other reasons for this step were the introduction, a year previously, of

The Power of Armstrong Siddeley

The Sapphire turbojet is already celebrated as the power unit for some of the world's most powerful fighting aircraft on both sides of the Atlantic. Now it is chosen to power the French Vautour S.O. 4050-03 bomber—claimed as the first bomber in the world to reach Mach 1. This is further evidence of the strategic importance of the Sapphire—and the almost universal power of Armstrong Siddeley aero engines.



ARMSTRONG SIDDELEY MOTORS LIMITED

PARKSIDE · COVENTRY

Members of the Hawker Siddeley Group

SKEETER Mk.6

ordered by

Her Majesty's Government

The Saunders-Roe Skeeter Mark 6 is powered
by a de Havilland Gipsy Major 200 engine

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(Left) Predominant among North Atlantic freighters is the 300-m.p.h. Douglas DC-6A. This example is a Slick Airways aircraft on weekend lease to Airwork Atlantic. The Slick-Airwork contract guarantees the British airline a minimum each-way payload of 10,900 kg (24,000 lb).

These representatives of Atlantic freight crews are (left) two flight engineers of Slick Airways and an Airwork cargo courier, who is responsible for all freight—live or otherwise—from the moment of loading. Slick's aircraft carry a duplicated crew—two captains, a co-pilot, two navigators and two engineers.

INTRODUCTION TO AIR FREIGHT . . .

Stratocruisers offering rather more freight capacity than is usual in passenger aircraft, plus the consideration that the C.A.B. were not prepared to take into account losses incurred on freight services when calculating transatlantic mail pay. In 1951 T.W.A. also withdrew their freight service, the aircraft being diverted to the Korean air lift until September 1952, when flights were resumed. Early that year P.A.A. restored their transatlantic freight services, using DC-6As leased from Slick Airways; in this way the airline was able not only to strengthen its position in the freight market but also to gain operational experience of the more modern equipment and, incidentally, to train crews for the essentially similar DC-6Bs then on order for passenger services. Subsequently PanAm ordered their own fleet of three DC-6As, which entered service last year and are now operating regularly across the Atlantic.

K.L.M. also have modern equipment (two DC-6As were added to their fleet in 1953) but their regular transatlantic services are still operated by DC-4s, as are those of T.W.A. Another DC-4 service now suspended was that of S.A.S. The only other passenger carrier to have entered the Atlantic all-freight field is Swissair who, like T.W.A., are at present operating a single weekly DC-4 service.

Though B.O.A.C.'s Stratocruisers and Constellations have always carried their fair share of the supplementary freight flown across the Atlantic, the Corporation has never operated all-cargo services. British interest in this new market was considerably stimulated by the civil aviation policy introduced by the present Government in 1952, which laid down, in effect, that non-subsidized independent airlines would thenceforth be granted freedom of opportunity to develop all-freight routes. B.O.A.C. then undertook not to seek to extend their freight services during the next twelve months, and shortly afterwards two independent carriers, Airwork and Hunting, applied for licences to operate regular North Atlantic freight services.

British Government approval of Airwork's application was announced in February 1953. The independent airline's next step was to obtain through the C.A.B. a "foreign air carrier permit," a formality which took a further fourteen months to complete; approval was also obtained from the Canadian Government for Airwork's freighters to pick up and set down traffic at Montreal. It was Airwork's original hope to inaugurate services as soon as possible after completion of these formalities, using an interim type of aircraft (such as the York) until a suitable freighter of British manufacture became available. In this context, the company has not concealed its interest—a continuing interest, incidentally—in the cargo version of the Britannia.

Meanwhile, in view of the increasingly competitive nature of the route, it came as no surprise when, in August 1954, Airwork announced an order for two DC-6A Liftmasters, for delivery early in 1956. Contracts were subsequently signed for two more DC-6As, and it is now hoped that the first of the four will be delivered next November and that operation of at least two will begin in January 1956.

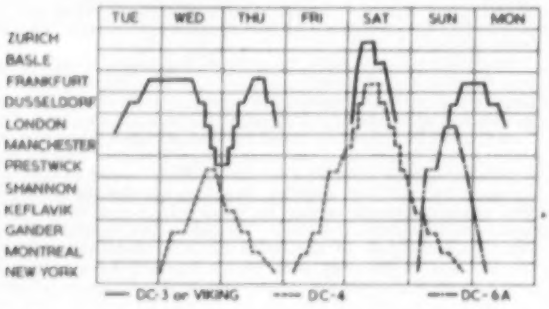
Scheduled services under the Airwork flag began on March 1st with aircraft leased from American carriers. Transocean Air Lines are at present providing two week-day return flights with DC-4s, and a weekend DC-6A flight between London and New York is made on Airwork's behalf by Slick Airways. Each Monday night, a few hours after its return from London, the DC-6A departs from New York on a scheduled Slick service to Chicago, Kansas City and Los Angeles, enabling the British airline to offer straight-through service to these inland and West Coast points without trans-shipment. British pilots, navigators and engineers form part of the crews of these American-operated services, and in this way Airwork are building up a reserve of type and route experience preparatory to the operation of their

Rhesus monkeys from India are loaded aboard a New York-bound DC-6A at London under the supervision of an R.S.P.C.A. inspector (left). Some 90,000 of these animals flew the Atlantic last year.

(Right) Transocean DC-4 on charter to Airwork Atlantic. Guaranteed minimum payload for this type is 7,000 kg (15,400 lb); capacity of the unpressurized hull is 3,200 cu ft, compared with the DC-6A's 4,800 cu ft.

Inside a DC-6A: the sturdy wooden floor-covering and cabin insulation are studded with shackling points. Dimensions of the main loading hatch, situated aft, are 10ft 4in wide by 7ft 6in high.

Loading a DC-4, a type which has given several years of valuable interim service as a transatlantic freighter. Cargo-door dimensions are 8ft 10in wide by 5ft 5in high.



Distribution and frequency of Airwork's Atlantic and European cargo services over a typical seven-day period. The actual schedules flown in any given week might vary slightly from those shown, since some landings ("flagstops") are made at the demand of traffic, whereas others ("technical" stops) are made for refuelling purposes only.

INTRODUCTION TO AIR FREIGHT . . .

DC-6As next year. Each aircraft also carries an Airwork "cargo courier," an official of many responsibilities, including completion of import documents *en route*; supervision of unloading; and fulfilment of special instructions for delivery, pick-up or trans-shipment of consignments. Employment of airborne cargo attendants is an Airwork innovation, and the company reports that the policy is already paying dividends.

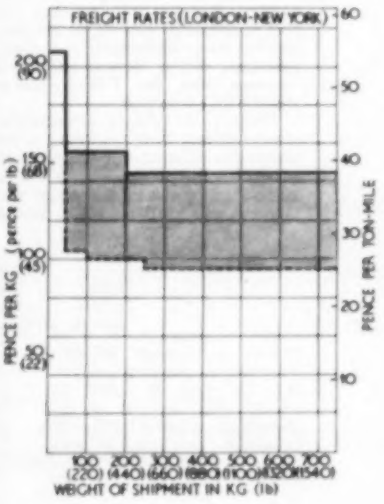
Airwork Atlantic, the division formed to develop the new freight service, are now firmly established on both sides of the ocean. In charge of the company's interests in North America is Mr. John Muhlfeld, formerly general sales manager of Pan American and a personality associated with more than one significant development in post-war air transport. Mr. Muhlfeld was among the prime movers in the planning and international discussions which led directly to the growth of freight traffic between the United States and Latin America, the introduction of transatlantic tourist fares and, most recently, the birth of the extremely successful deferred-payment system launched by P.A.A. and adopted by almost every other major airline.

The compact and highly experienced Airwork Atlantic sales organization in America is backed up by the powerful Furness Withy shipping concern, whose acquisition of a substantial share in Airwork, Ltd., was announced last year; cities in which Furness Withy act as general sales agents for Airwork include Boston, Baltimore, Norfolk, Philadelphia, Chicago, Seattle, Portland, San Francisco, Los Angeles, St. Johns, Halifax, Montreal, Toronto and Vancouver.

As indicated by the frequency chart on this page, Airwork Atlantic offer considerably more than a pipeline service between London and New York; feeder services are already bringing in traffic from several British and Continental cities and plans exist for further extension of the network. Already one of the three-weekly transatlantic flights penetrates beyond London into Germany, and it is expected that Airwork's own DC-6A services will also operate into the industrial heart of Europe. Given sufficient promise of traffic—and results to date are encouraging—the company hopes to achieve a daily frequency of transatlantic service, westbound and eastbound, some time in 1956.

Barely three months have passed since Airwork's entry into the ranks of the transatlantic airlines, so it is too soon to gauge progress on the basis of tonnages carried and load factors achieved. The company does not expect its first year of operations, particularly those performed with leased aircraft, to show a net profit; present indications are, however, that the initial deficit will be considerably below the figure anticipated. It would also be premature to attempt a detailed analysis of the classes of cargo now moving *via* Airwork Atlantic, because each day brings bookings for new types of traffic.

Airwork Atlantic's load manifests might well inspire the Poet Laureate to add a new and slightly surrealistic stanza to his classic *Cargoes*, so oddly varied are their contents. The authenticity of the following extracts is guaranteed: from New York—golf clubs, insecticide, blueprints and clutches for London; gaskets and ham for Amsterdam; collar buttons for Kuwait; cone-spun Dacron for Helsinki; dental resin for Berlin; typewriter parts for Calcutta; coal-tar dyes for Karachi . . . Consignments lately flown westward from London have included 40 cases of machinery and one box of china for New York, one parcel of "waving fluid and advertising material" for Sydney, clothing for Wellington and cases of aircraft parts for Winnipeg. R.J.B.



This chart is intended as a guide to the present structure of transatlantic air-freight charges. The bold upper line shows the "basic" rate, which varies according to the size of consignment. Within the tinted area lie a wide range of rates for "specific commodities," designed to attract the maximum flow of goods best suited to air shipment. The present tariff contains some 1,000 variations from the basic rate, but on July 1st I.A.T.A. airlines will introduce a new, simplified rate-structure grouping commodities under 35 to 50 generic headings. The basic-rate discount for loads of 200 kg and above will be withdrawn, but rates for certain commodities will be cut by 20 per cent or more.

APRIL 1955

T.C.A. passenger increase on March : **57%**

Load factor on Toronto-New York service : **90·4%**

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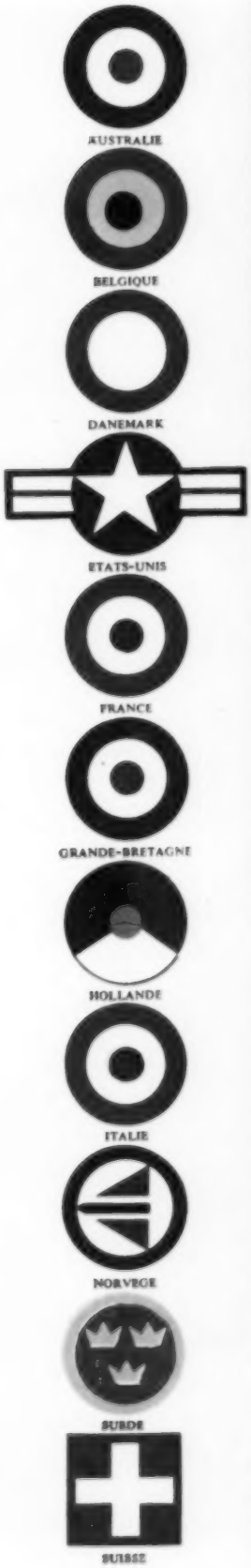
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BELGIQUE
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ITALIE
NORVEGE
SUEDE
SUISSE

LES ALLIAGES NIMONIC*
Utilisés jusqu'à ce jour par de nombreuses nations pour les fabrications aéronautiques (ailettes de rotor et de stator, tubes à flamme et autres éléments vitaux des turbines à gaz), ces alliages résistants à chaud sont maintenant à la disposition de toute l'industrie mécanique. La série des alliages Nimonic pour les applications aux températures élevées a été étudiée pour résister aux températures et aux efforts de plus en plus élevés rencontrés dans la mécanique moderne. Ils réunissent la résistance au fluage, à la fatigue et à l'oxydation aux hautes températures de façon uniforme et sûre.
* NIMONIC est une marque déposée
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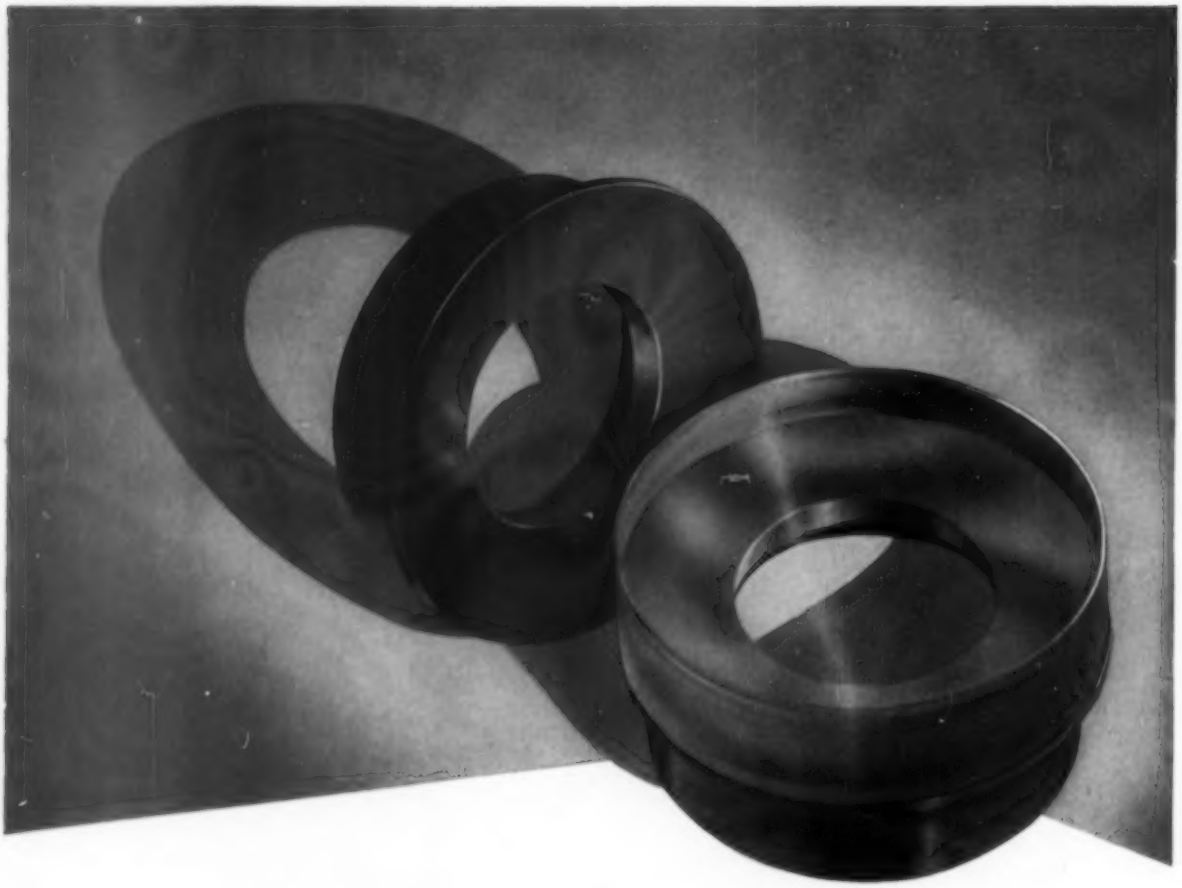

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The Background to the Paris Show

IN this issue of "Flight," appearing on the eve of the Paris Aero Show, it is appropriate that the current state of aviation in France should be briefly reviewed. In the three articles which follow, specialist contributors discuss the post-war products of the industry; the flourishing light-aircraft movement; and commercial aviation. The facts given will, we feel, be of particular value to Show visitors as "background" information.

FRANCE'S AIRCRAFT INDUSTRY

IN the first years of peace it seemed that the French aircraft industry might never be able to rise from its ashes. Constructors were hurling themselves headlong into the design and manufacture of dozens of different prototypes with no co-ordinated plan. Such short-term work promised no lasting success; rather was there the likelihood that the more enthusiastic firms would soon founder as a result of the expense, the aimlessness and the continual technical setbacks. For these reasons it seemed unlikely that France, with the heavy handicap of four war years of inactivity, during which many technical advances had been made abroad, could once again take a powerful place in world aviation.

But, in less than ten years, and contrary to all expectations, the industry has succeeded in overcoming its great handicap, so that today a number of projects have proved their worth and have aroused the interest of both technicians and operators abroad.

Intercepters and Research Aircraft.—New construction began when the French Air Force, equipped in the immediate post-war years exclusively with foreign operational aircraft, asked S.N.C.A.S.E. to build 185 Vampire 5s under licence and then 250 Mistrals, derived from the Vampire 5, but fitted with S.N.C.A.S.O. ejector seats and powered by Hispano Suiza-built Nenes. As a first step, this work absorbed the production capacity of the modern factory at Marignane while various entirely French prototypes were being tested. Then an order was placed for 350 Dassault 450 Ouragans for the Air Force, these also being powered by the Hispano Suiza Nene. This was not only the first all-French jet intercepter ordered in quantity, but also the first to be exported; the Indian Air Force placed an order for more than a hundred of them.

The Ouragan is now obsolescent, but France has two aircraft which could equip all her squadrons and take care of each of the country's tactical requirements. The first, the Dassault Mystère IV, now in production and the subject of off-shore orders, is an aircraft of international standing, both in performance and fire-power. If, as has been announced, production is hastened, the Air Force will soon have a first-class intercepter. The Mystère II, also in production, is no longer of major importance, because orders have been reduced since it was overtaken by the Mystère IV. The reduction was further justified by delays caused by structural faults.

From S.N.C.A.S.O. a production batch of 140 S.O.4050 Vautours has been ordered and should provide equipment for all-weather, light bomber and attack wings. The three versions developed show that the Vautour is perfectly adapted to each of these rôles.

In the Mystère and Vautour, France has two airframes which are strong, well designed, extremely versatile and, above all, thoroughly and carefully equipped with all weapons systems, including radar. This leads to the further observation that France is far from having made up her post-war lag in engine design. Hispano Suiza build British turbojets under licence and S.N.E.C.M.A. has only the Atar, the Vulcain being still in the experimental stage. On the other hand, a great and successful effort has been made to provide French equipment for the new aircraft. In fact, whether it be instruments, radio, electronics or other items, 80 per cent of the equipment required for a complex modern aircraft is now produced in France.

Very soon, by present indications, French military aircraft will not only satisfy the requirements of the French Air Force but also constitute an attractive proposition on the international market, though this does depend on rate and volume of production. In this connection it seems that, despite the established production capacity of factories like those at Marignane, Toulouse, Bordeaux, St. Nazaire, and elsewhere, financial support is lacking; and for this reason, production is far from attaining its full potential.

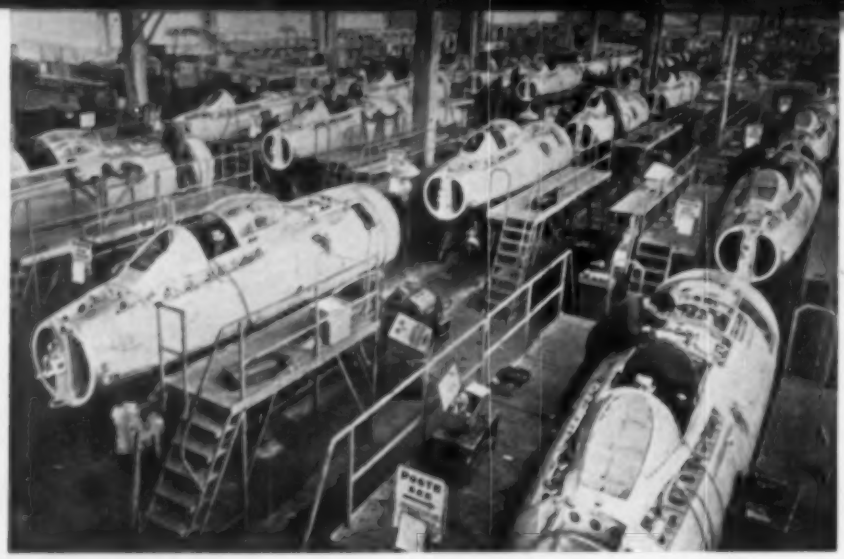
Apart from the problem of production, there is the question of experimental aircraft at present under development; and the first of these are the Leduc types.

For some years René Leduc has been working steadily on his projects, and the apparent slowness has led some to wonder whether the Mach 2 machine will ever see the day. But there can be little doubt that it will do so. The ramjet in itself is a revolution as great as that of the turbojet; yet in this case there has been not only the question of developing a powerplant, but also that of evolving an airframe since, because of the size of the duct, the whole aircraft had to be designed to accommodate it. And furthermore, to aim at such high speeds meant solving the problems which inevitably arose, such as those of powered control, ejection at high speeds and altitudes, kinetic heating, manœuvrability and high fuel-consumption. All these problems have been overcome in Leduc types 010, 016 and 021 and the solutions incorporated in the 022. Even independent take-off, with an Atar, has been provided for the swept-wing version which is now being built. If René Leduc announces that Mach 2 in the climb will be achieved in 1956, and ascent to 80,000ft in five minutes, there is no reason to doubt his statement.

The race between the Leduc 022 and the S.O.9000 Trident, which is even now going through its last series of tests, will be a close one. With its Viper turbojets and three-barrelled rocket motor the latter aircraft has the advantage of great flexibility of operation. Its main characteristics are rapid climb, high ceiling and supersonic speed; and its armed military equivalent, the S.O.9050, is of course already being built. Its armament is secret, but is specially designed for high-altitude interceptions at speeds in excess of Mach 1.5.

The Trident's three-barrelled rocket motor is checked, as are the cockpits of the fourth Vautour (top of page) in its bomber version.

FRANCE'S AIRCRAFT INDUSTRY . . .



French production capacity, illustrated by the Ouragan line at right, is at present devoted substantially to the Fouga Magister, the Mystère IVA and the Vautour, arranged in that order in the pictures below.

"Flight" photograph

In the purely experimental field the delta-winged Nord 1402 Gerfaut is certainly a success for it can exceed Mach 1 in level flight merely on the 6,600-lb thrust of a production Atar. The very small area of its original wing gave it a landing speed high enough to make use of a tail braking parachute obligatory, but the larger wing now fitted has considerably reduced the landing speed without detracting from performance, either in speed or rate of climb.

The S.E.5000 Baroudeur, with its take-off trolley and landing skids, attracted a great deal of attention in France; nevertheless, this scheme does not appear to have a great future. The German Arado company tried similar expedients in 1943, only to abandon them later; and in any case the Baroudeur itself does not seem to be a great success.

Military Training Aircraft.—France can undoubtedly claim to be the pioneer in the field of light jet aircraft; and, thanks to the progressive collaboration of Fouga and Turboméca the present healthy stage of light jet design has been reached. The Fouga C.M. 170R Magister is a very successful machine with a performance comfortably greater than that of the Vampire, and with equipment particularly designed to make it a good trainer right up to Mach 0.83. Ten of the production series for the Air Force are already flying. Fouga's example was very soon followed in France, when their direct competitors, Morane Saulnier, produced the M.S.755 Fleuret; this was developed into the first four-seat jet liaison aircraft, the M.S.760 Paris which Beechcraft will probably build under licence in America. There are also the tiny Sipa 200 Minijet and Sipa 300 which, like the Payen P.A.49 delta, are powered by the Turboméca Palas of 330 lb thrust. Even though there is little chance of these aircraft ever reaching the production stage, they illustrate very well what can be achieved with small turbojets. France showed the way, England followed with the Jet Provost, and similar projects have shown the interest of Italy and America.

The application of small turbojets to helicopters—particularly to the S.O.1221 Djinn, now in production, and the S.E.3130 Alouette II—should not go unmentioned.

Transport Aircraft.—Several French transports of a few years ago met with no particular success. An exception was the Bréguet 763 Deux Ponts, which has done extremely well with Air France. If this aircraft had been built in greater numbers and more quickly, it is certain that, at a lower first cost, it would have been successfully used by many more companies. Now there is the twin-engined Nord 2501 Noratlas, ordered by the Air Force, which seems to have some very interesting prospects on the civil market. Then, on their S.E.210 Caravelle, S.N.C.A.S.E. are basing great hopes for the future. The company were able to draw on the results of Comet experience and to apply some ingenious solutions to the medium-range jet transport, which is one of the great projects of the immediate future.

In quite another category of civil aircraft, the Hurel-Dubois H.D.32 is still arousing great interest as a freight aircraft for operation from rudimentary airfields. The application of the high-aspect-ratio wing to an aircraft of 44,000 lb a.u.w. is a most interesting proposition; but it is curious that production of so promising a machine should be so long delayed.

In another sphere, Max Holste is overloaded with orders for the Broussard, which has shown itself to be a direct rival of the Beaver for both military and civil applications.

Prototypes in the Design Stage.—There are two separate categories of projects under this heading. Firstly, there are those intended for immediate operation, yet incorporating the latest technical advances. They include the delta-winged Dassault 550, S.E. Durandal and Bréguet Taon, which are the future weapons of the Air Force. Secondly, there are signs of com-

(*Concluded at the foot of page* 804)

l'AVIATION LÉGÈRE et SPORTIVE

The French Government-sponsored Popular Flying Movement

IT was in October 1946 that the Service de l'Aviation Légère et Sportive was brought under the aegis of the French Ministry of Civil and Commercial Aviation; and its functions were closely defined by statute.

The Service was charged with supervising all questions of aero-modelling, ballooning, parachuting, gliding, light aircraft flying and club flying, and with general propaganda and the aeronautical indoctrination of youth. It was also charged with assembling the wherewithal for private and club flying, i.e., airfields, installations and material, and with organizing the national centres intended for the training of instructors and other personnel.

This resulted in three main branches of activity; firstly, the organization and control of light aviation activities, secondly, the aeronautical instruction of young people and, lastly, the preparation for recruitment into any of the armed forces of pilots and aeronautical specialists. All the various activities mentioned in the original statute were therefore vigorously pursued, including financial assistance for both the young and not-so-young, either to learn to fly or to continue their training as Air Force reservists. These activities were co-ordinated with the national education authorities and with the armed forces, and thus general and specialized aeronautical training became the principal functions of the Service.

The realization of the above programme was predicated on the availability of materials, airfields, instructors and methods. All materials for basic and advanced instruction and for the various types of flying have therefore been designed and provided according to the directives of the Service, which is the government agency responsible for defining the movement's needs. Aircraft constructors produce prototypes which the Service tests in relation to the requirements of the centres and aero clubs; and if the material is suitable it is ordered by the State as well as by private individuals. Since 1954, aircraft ordered under this system and operated for the Service by the clubs have been ceded to them at a token price. For their part, the clubs receive maintenance subsidies. These are now also provided to help in the purchase of equipment to the tune of 60 per cent of the value of an aircraft, and they are available also to private buyers and to the growing number of amateur constructors. Beginning this year, the Service is also to start operating helicopters and light jet aircraft at its centres.

Particular conditions apply at airfields, and here also the Service has stipulated new layouts such as grass runways to replace plain landing areas and hangars having a large opening frontal area and shallow depth. The network of airfields is now so arranged that an aircraft flying over metropolitan France will never be more than 30 km away from an operating airfield.

Instructors are trained according to a standard French method and are placed at the disposal of the flying clubs from the relative centres. They are qualified to teach flying, parachuting, technical subjects or aero-modelling, being drawn for the latter mainly from school teaching staffs.

New methods are at present being developed, particularly for piloting, to produce a progressive and blended combination of glider and powered flying and for parachute instruction. It is hoped, by this standardization of instructional techniques, to improve the standard of flying and also to increase safety.

The Service also undertakes aerological research into atmospheric conditions, thus assisting in the general study of meteorology. In this connection, the glider has shown itself to be the ideal vehicle for the study of upper atmosphere conditions. But, as yet, the greatest heights attained have not taken gliders beyond the troposphere, the French record being 27,400ft and the world record 42,400ft. Present research has as its aim the construction of light aircraft, both powered and unpowered, capable of carrying out investigation into the problems affecting all high-altitude

French light aircraft supplied by the Government to the clubs and centres include (from top to bottom) the Stampe, the Breguet 901 and the 75 h.p. Sipa 92. 700 of the first, 60 of the second and 150 of the third have now been issued.

(Right)) The French glider pilot Gerard Pierre, world champion in 1954.

l'AVIATION LÉGÈRE et SPORTIVE . . .

flight. In another sphere, the Service has assisted doctors in finding new remedies, particularly for such illnesses as whooping cough. Finally, the clubs help in detecting and fighting forest fires and attempting to avert hailstorm damage and, more generally, to assist in the protection of a variety of crops.

In the eight years since the Service was attached to the Ministry, the following results have been obtained:—

Elementary flying licences, 20,000; 5,000 aero-modelling centres established; 878,000 hours of powered flight; 12,000 powered piloting licences, first grade; 4,500 powered flying licences, second grade; 567,115 glider flying hours; 11,000 B certificates; 7,800 C certificates; 1,850 D certificates; 160 E certificates; 12 F certificates (out of the total of 31 in the world); 25,200 parachute jumps since 1948; 725 first-class parachute licences; 319 second-class parachute licences; 26 qualified parachute instructors; 4,031 air force pilots; 38,667 military non-flying specialists; 350 army air-observation pilots since 1953; 60 new airfields have been set up.

More recent activities sponsored by S.A.L.S. are parachuting, for which a practice tower is seen at left, and ultra-light flying. The pilot of the Jodel Bébé (above) is manipulating his own chocks.

Organization, running and development of light and sporting aviation faces two principal difficulties; firstly, shortage of government-supplied funds and, secondly, growing restrictions on general flying. Financial difficulties have a marked effect on policy. For instance, they have caused aircraft to be handed over to the clubs, since the Service could no longer cover the costs of overhaul and repair. Because of this, despite maintenance grants, a large number of aircraft are grounded because the clubs themselves have not the money to keep them flying. Charges per flying hour will therefore have to be raised in order to meet new costs, and this again will reduce activity. Future financial allocations will be even smaller than hitherto and this process can only be countered by freeing petrol from taxation or by increasing subsidies. It seems that the first solution would be less costly to the state.

By the same token, the maintenance and renewal of gliders cannot be kept up to assure continuance of the present scale of utilization. In another sphere, general flying in light aircraft and, above all, in gliders, is becoming increasingly hemmed in by the strictness of air traffic rules now being instituted because of the increase in general commercial traffic—and, particularly in northern and eastern France, by the appearance of new military air bases. C.B.

[**Tailpiece:** It may be recalled that the scheme operated by the Service de l'Aviation Légère et Sportive for the testing and airworthiness certification of amateur-built ultra-light aircraft has formed the basis for that recently adopted by the Popular Flying Association in this country. The French influence on the present re-birth of British ultra-light flying is even more clearly indicated in the aircraft types chosen by the P.F.A. to inaugurate this new era—the single-seat Druine Turbulent and the two-seat Turbi. The Air Registration Board representative on the technical committee of the P.F.A. has expressed enthusiastic approval for the high standard of design and workmanship and sense of responsibility shown in the French light-aircraft movement: based on the tried S.A.L.S. procedure, the new British system should now be able to produce a heartening increase in ultra-light activity in the United Kingdom—Ed.]

WINGED FRENCHMAN

"Bird Man," by Léo Valentin. Hutchinson, Stratford Place, London, W.1. Illustrated. Price 12s. 6d.

THIS book will make exciting reading for those who like their aviation literature on the gory side. Valentin, who made his first parachute descent in 1938 at the French Military Parachute School at Baraki, Algeria, is now one of his country's leading parachutists. He had already completed almost a hundred drops when, after the fall of France, he found himself under training as a "novice" at a British parachute school; and in June 1944 he was dropped with a unit of the Special Air Service at Morbihan, with instructions to blow up the railway lines between Vannes and Rennes.

Valentin describes how he worked to find a way of remaining in a stable position during long free falls, and finally succeeded in discovering what he calls the "Valentin Position." Starting from and returning to this position, he was able to carry out various aerobatic manœuvres while falling freely with the parachute unopened. Finally, tiring of these variations on a theme, he set out to try to fly with canvas wings attached to his body.

His attempts were unsuccessful, and several times they placed him in extremely awkward situations. Finally, deciding that with canvas wings he could only achieve "braked fall" and not true flight, he turned his attention to wings made of wood. With these he made a number of practice flights, culminating in a successful glide in which he covered a distance of three miles for a loss of height of six thousand feet.

Looking into the future, Valentin says, "One day I shall probably be able to land [without a parachute] but I am in no hurry. I don't want to go too fast." His decision not to hurry will probably come as a relief to the reader whose appetite may have been impaired by his graphic descriptions of fatal accidents.

In 1949, feeling the urge to make longer delayed drops, he decided to establish a record for a free-fall descent without oxygen. Leaving the aircraft at 22,000ft, he dropped to 1,800ft before opening his parachute. This was a dangerous but successful experiment.

One jarring note in this book is the way in which Valentin manages to leave in the mind of the reader doubts about the courage of some of the people of whom he writes—notably a helicopter pilot who died in an accident, and a champion parachutiste of France.

Those who know Monique Laroche (as does this reviewer) will smile at the author's description of the double jump, from an Auster, that did not quite come off. The inference is that she was afraid; but a cool and reasoning brain works inside the pretty head of that French doctor's wife. If Monique decided that the jump was about to prove *fatale* to that particular *femme*, then she was probably right.

This is an interesting book written by a man of undoubted courage. It is therefore worth reading. Having read it, one finds the author's warning to others not to emulate him a little superfluous. T.W.W.

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Automatic monitoring provides a continuous check of the accuracy and correct functioning of the equipment.

The illustration shows the local equipment console. Both receivers, the aerial mixing unit, modulators and associated oscillators, corresponding to a twin channel equipment are all built into the one cabinet. The bearing indicator meter for monitoring is common to both channels, and can be switched to either. Remote control and display units of similar design are required for each channel. Desk mounted bearing repeater units are available for display at other points.

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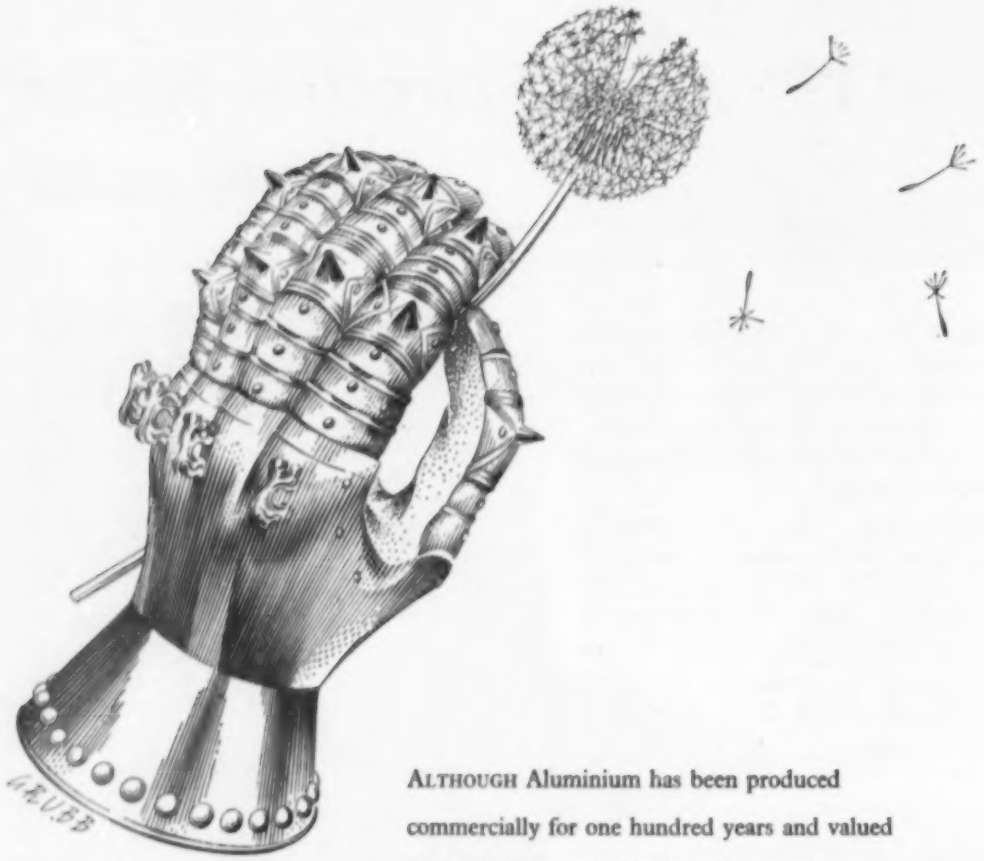

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France's first jet airliner, the S.E.210 Caravelle, shown during its first take-off on May 28th at Toulouse-Blagnac.

FRENCH COMMERCIAL AVIATION

Extensive World Networks: Plans for Domestic-route Expansion

THE first French air services, which can also claim to have been first in the world, started in 1919 with the formation of several companies. In December 1918, the Latécoère Airline Company had made the first proving flight between Toulouse and Barcelona with a view to establishing a route to Africa and eventually to South America as well. A few months later came services to Rabat (September 1919) and to Casablanca (December 1919). At the same time, the Farman Company inaugurated services between Paris and London and Paris and Brussels (February 1919).

Several airlines were started after this, expending great effort and suffering heavy losses in the process; but the development of air transport in other countries, and the necessity for intensifying efforts in order to resist international competition, made it necessary at the beginning of 1931 to establish a more efficient organization and closer co-ordination of services. Therefore, on August 30th, 1933, Air Orient, Air Union, the Compagnie Générale des Transports (Farman) and the Compagnie Internationale des Transports Aériens merged to form Air France.

Immediately Air France took over and co-ordinated the operation of the routes of these companies. The network—comprising 24 lines and 38,000 km—linked France with the principal European capitals, the major cities of North Africa, Dakar (and South America through a surface link, Dakar-Natal), Tripoli and Saigon.

On the eve of the World War 2 France ranked third in world air transport, with a route-length of 65,700 km, following the United States with 115,000 km, and the U.S.S.R. with 93,000 km. In traffic density France came fifth after the United States, the U.S.S.R., Great Britain and Canada.

At the liberation, French airlines were militarized under the direction of the provisional government and divided into three networks. It was not until Air France began operations once more that regular links between metropolitan France, her colonies, and other countries were re-established.

In 1945, the number of passengers carried already exceeded the pre-war level, and, in 1946, the Air France network included 68 routes and covered 160,000 km, as opposed to 46,000 km in 1938. In 1949, for the first time, the passenger-kilometres figure passed the thousand million mark, and by 1954 this figure too had been doubled. These remarkable results, obtained over a world-wide network, show the extent of the activity of the French national airline company; the route mileage covered is, at the moment, over 300,000 km.

Independent Companies.—A number of private companies sprang up after the war beside Air France. Their operations were necessary to create competition and, principally, in order to prevent Air France from weakening itself by over-extending an already stretched route network. Combined, the French airlines now rank third in the world behind the U.S.A. and Great Britain. During 1954 the British companies carried a greater number of passengers but, by contrast, the French were ahead in freight transport.

After the war a great number of private operators began business, but gradually they disappeared, either because they over-

An Air France Super Constellation, representative of much of this airline's American equipment. Twelve of the new Lockheed L-1649As have also just been ordered.

Two Nord 2501 Noratlas (shown here) are in service with U.A.T. and more are to follow. The French Air Force also has considerable numbers of them and further civil orders are to be expected.

FRENCH COMMERCIAL AVIATION . . .

lapped each other or because funds were lacking. At the moment, six important private companies remain besides Air France to exploit a route-network which, in the writer's opinion, is the best in the world. It links all parts of the globe and provides the quickest connections between them.

The most modern equipment is used on these routes, including several French types, notably the Bréguet Deux Ponts, the Nord 2501, Noratlas and the S.O.30P; these will soon be supplemented by the H.D.32 and the S.E.210 Caravelle.

There are, as well, several private companies operating within the French Union. Plans are in hand for increasing the potential of commercial aviation and particularly for the creation of an additional feeder-line network inside metropolitan France to connect the main trunk routes. This would be in addition to that of the Aéro-Postale which, every night, with an annual regularity of 99 per cent, carries airmail between the major French cities.

The Bréguet Provence (upper), which has given excellent service with Air France; and the latest tail configuration of the high-aspect-ratio H.D.32 (bottom) as it appeared at Shoreham recently.

In 1946, all companies together carried 298,186 passengers and 5,084 tonnes of freight. In 1951, the figures were 1,458,884 and 65,259.2; in 1954, 2,169,830 and 80,555.6. This progressive increase in traffic shows the growth of French commercial aviation, whose fleet in metropolitan France alone consists of 72 twin-engined and 115 four-engined aircraft. This does not include single-engined aircraft and helicopters used by the smaller concerns. The principal companies are as follows:—

Aigle Azur. Head office: 70 Champs Elysées, Paris VIIIe. Aircraft fleet: 3 DC-6, 2 Stratoliner, 2 DC-3. Personnel: ground, 228; flight crew, 108. Traffic in 1954: 3,051,200 km flown; passengers, 9,296; passenger/km, 92,172,000; freight, 275.2 tonnes; tonnes/km, 2,096,600.

Air France. Head office: 2 Rue Marbeuf, Paris VIIIe. Fleet: 9 Super Constellation, 20 Constellation, 20 DC-4, 12 Viscount, 11 Provence, 9 Languedoc, 37 DC-3, 4 Ju52, 10 Goeland, 5 Alcyon, 5 Safir; during the year seven more Super Constellations (of 10 ordered) should arrive, and H.D.32s are expected to replace DC-3s on some routes abroad. Personnel: ground staff, 14,338; commercial staff, 529; flight crew 1,056. Traffic in 1954: 65,673,000 km flown; passengers, 1,526,767; passenger/km, 2,044,159,000; freight, 41,675.2 tonnes; tonnes/km, 52,616,700; mail, 11,084.4 tonnes; tonnes/km, 21,108,300.

C.C.T.A. Head office: 167 Avenue Poeymirau, Casablanca, 35 Rue du 4 Septembre, Paris IIe. Fleet: 3 DC-4, 5 DC-3. Personnel: ground, 371; flight crew, 72. Traffic in 1954: 3,580,400 km flown; passengers, 79,011; passenger/km, 86,736,000; freight, 1,381.6 tonnes; tonnes/km, 1,589,200; mail, 238 tonnes; tonnes/km, 291,200.

Compagnie Générale de Transport Aérien: C.G.T.A. Air Algérie. Head office: 46 Boulevard St-Saens, Algiers, 4 Rue Auber, Paris IXe. Fleet: 2 DC-3, 4 DC-4. Personnel: ground, 396; flight crew, 52. Traffic in 1954: 3,314,300 km flown; passengers, 104,079; passenger/km, 104,463,000; freight, 1,671.7 tonnes; tonnes/km, 1,829,600; mail, 0.7 tonnes; 300 tonnes/km.

Transports Aériens Intercontinentaux: T.A.I. Head office: 23 Rue de la Paix, Paris IIe. Fleet: 2 DC-6B, 3 DC-4. Personnel: ground staff, 480; flight crew, 170. Traffic in 1954: 7,970,300 km flown; passengers, 43,672; passenger/km, 242,339,000; freight, 1,638.7 tonnes; tonnes/km, 7,508,800; mail, 200.8 tonnes; 1,583,200 tonnes/km.

Tunis Air. Head office: 1 Rue d'Athènes, Tunis. Fleet: 4 DC-3, 1 DC-4. Personnel: ground, 86; flight crew, 26. Traffic in 1954: 1,488,500 km flown; passengers, 38,934; passenger/km, 17,857,000; freight, 219 tonnes; tonnes/km, 108,300; mail, 69.8 tonnes; 300 tonnes/km.

Union Aéromaritime de Transport: U.A.T./Aéromaritime. Head office: 5 Boulevard Malesherbes, Paris VIIIe. Fleet: 2 DC-6C, 2 DC-6B, 9 Heron, 1 DC-4, 2 Noratlas. Personnel: ground, 885; flight crew, 164. Traffic in 1954: 7,940,900 km flown; passengers, 83,631; passenger/km, 159,572,000; freight, 5,210.9 tonnes; tonnes/km, 9,255,000; mail, 473.4 tonnes; 963,000 tonnes/km. R.R.

FRANCE'S AIRCRAFT INDUSTRY

(Continued from page 800)

pletely original projects which emphasize the desire of French engineers to break new ground. In this context can be mentioned the Bréguet 940 with boundary-layer control, the M.Ae.R.C.H. 100 gust-absorption aircraft, and the vertical take-off coleopter, not to mention the various V.T.O. projects which are being prepared by a number of companies.

Conclusion.—This survey, though mainly confined to aircraft of some international significance, would not be complete without mentioning the work put into touring, amateur-built aircraft and gliders in France. Nor should it be forgotten with what care French airframes and engines have been supported with equipment, construction methods and the scientific, experimental and control methods that form the basis of a well-balanced industry. Evidence of particular effort in this direction leads to the conclusion that the French industry has at last reached maturity, and that from now on it will hold an important place in world aviation.

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A typical Dunlop Hydraulic Brake circuit with associated components is illustrated on the opposite page.

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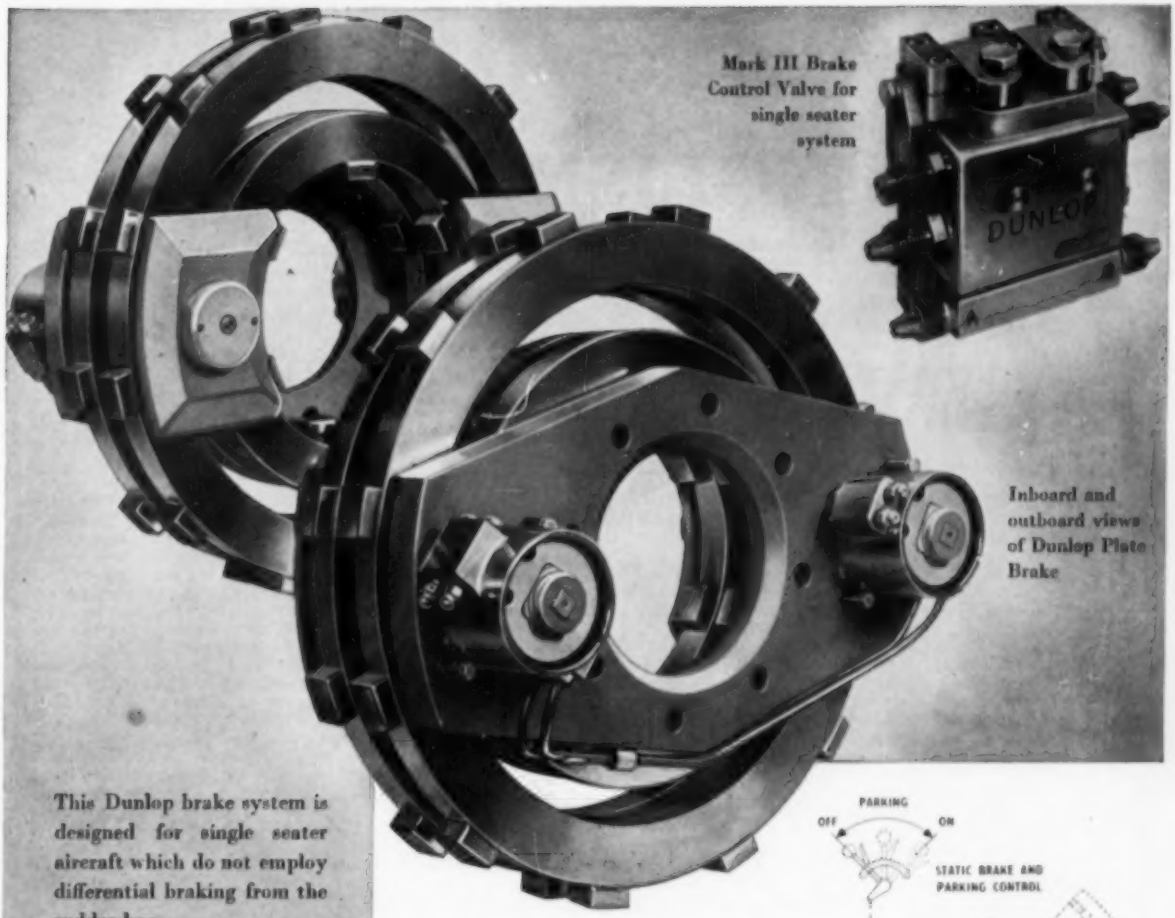

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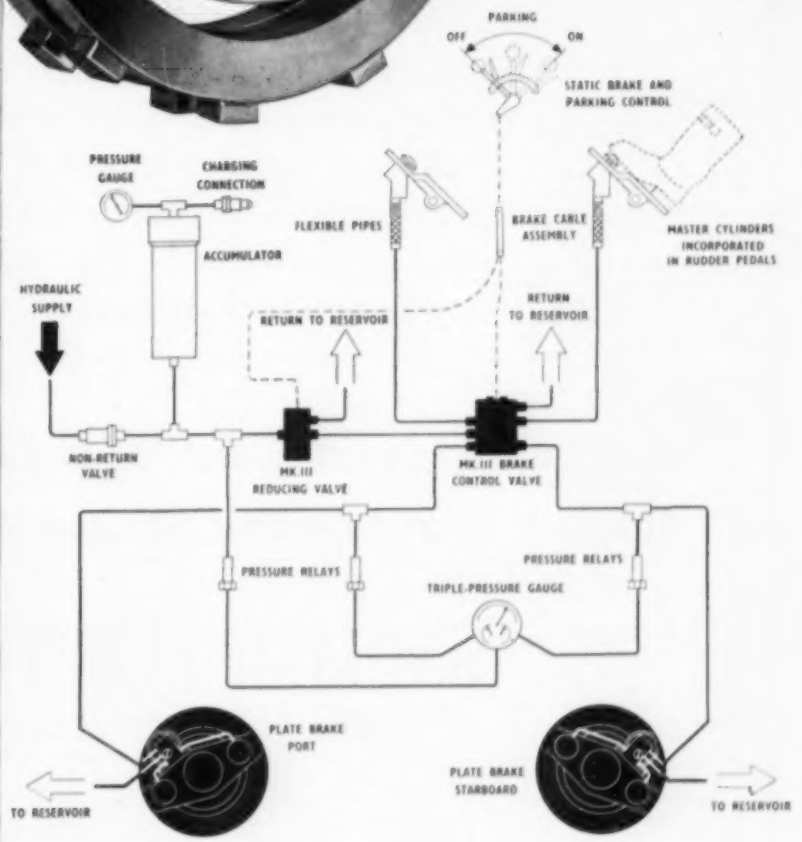

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ALUMINIUM ALLOY COMPONENTS

Modern Tendencies in Forging and Casting Techniques

By C. WILSON, Ph.D., A.R.S.M., D.I.C.*

IN recognition of the significance of the "Aluminium 1955" Exhibition, marking the centenary of the metal in Britain, this and the succeeding eight pages are given over to the subject of aluminium. We begin with this practical article by a specialist; a review of the light-alloy industry follows; and in conclusion there are brief notes on the aeronautical items at the exhibition.

SINCE the discovery by Wilm in 1909 of the aluminium-copper alloy and its capacity to increase in strength by "age hardening," some spectacular advances have been made in aluminium-alloy metallurgy. Some of these have stemmed from the aluminium-copper system, and the original alloy of Wilm has now developed into a whole family of alloys, which have found wide application in airframe structures. The family is a large one, comprising the earliest airframe materials known by the specification numbers L1, L39, D.T.D.150 and D.T.D.390 and the more modern alloys D.T.D.364, D.T.D. 546, D.T.D.646, L64, L65 and many others. Of this family also are such alloys as 14S, 17S and 24S, equally familiar to aircraft designers in America.

Some of the British specifications for alloys of this group are now obsolete or obsolescent, for the members of the family had become so numerous that some rationalization was necessary. In this process it was decided to retain a composition which could provide the naturally aged and precipitation-hardened properties in all wrought forms as required by L64, L65 and associated specifications. Nevertheless, this material is a developed form of the original Wilm alloy.

In modern aircraft, however, alloys of the aluminium-magnesium-zinc group are rapidly replacing those of the aluminium-copper series for structural parts; and the majority of airframe forgings, for example, are now produced to specification D.T.D.683. It is sometimes thought that alloys to this and allied specifications are new; but some components were manufactured in them prior to 1939 and certain alloys of the group became stabilized in composition as early as 1942. Large-scale usage of these materials is, however, of fairly recent origin; it has occurred since 1945, as the design of more efficient aircraft has demanded increasingly high strength/weight ratios.

The development of Wilm's alloy was not confined to structural alloys. Aero-engine designers early began to look to aluminium alloys for increased engine efficiency and during the First World War work by Rosenhain at the N.P.L. produced "Y" alloy, a material specially designed to operate at elevated temperatures. The field of application of aluminium alloys in engines was further enlarged with the introduction of the RR series of alloys, which have been produced as castings and forgings for most British engines and some American units. For the latest alloys of this series, suitable for operation at temperatures exceeding 300 deg C, a return has been made to the relatively simple aluminium-copper system (Hiduminium RR.57); and, even more recently, further improvement has been secured in hot strength by small additions of certain alloying elements (Hiduminium RR.250, RR.350 and RR.257). For some aero-engines, it also became necessary to produce an alloy with fair hot strength coupled with a low coefficient of expansion. This material, based on the aluminium-silicon system, was manufactured to D.T.D.324 in the form of forgings, principally for cylinder barrels.

Some alloys have also been developed for casting in the structural field. These have been based on the aluminium-copper system (L51 and D.T.D.304A), the aluminium-silicon (L33), the aluminium-magnesium (L53) and the aluminium-magnesium-silicon (e.g. D.T.D.735).

It is not the purpose of this article, however, to discuss the aluminium alloys introduced for aircraft applications during the past three or four decades. The main objective is to review the developments which have taken place in forging and casting techniques to meet the constantly increasing requirements of the aircraft and aero-engine designers. The advances in manufacturing techniques cannot be divorced from alloy considerations nor from associated procedures such as heat treatment and billet production, and reference to these factors will also be made.

FORGINGS

In the manufacture of forgings the principal stages are: (a) Manufacture of billet stock; (b) pre-forging processes; (c) die-forging processes; (d) pre-heat-treatment machining; (e) heat treatment; (f) inspection; (g) testing.

Manufacture of Billet Stock. Forgings are made either by direct forging, on open dies, of ingot stock, or from extruded stock. In both cases the quality of the initial ingot, in terms of soundness, freedom from non-metallic inclusions and uniformity of grain size, is of the utmost importance in determining the quality of the finished component. Stock of poor quality may not only cause rejection of the finished part through such causes as cracks and inclusions, but invariably give rise to excessive rejections during manufacture.

In the case of ingot stock, porosity, shrinkage and variations in grain size lead to difficulties during pre-forging; consequently, ingots for forging and extrusion receive rigorous inspection, involving examinations of macrostructure and fractured specimens from both ends of the billet. The microstructure is also inspected, at a specially selected position. In recent times this procedure has been supplemented by ultrasonic testing, which is capable of finding cracks and other faults in the interior of the ingot.

It is evident that much attention should be directed to the production of ingots of high quality, and a major contribution in this respect has been the development of the direct chill casting process. This method, the semi-continuous casting process, yields ingots of much higher quality than did earlier processes, though its efficiency diminishes in ingots of large diameter. The forger, therefore, will tend to use the smallest diameter ingot from which a given component can be made, even though this may involve a difficult upsetting operation.

The quality of extruded stock is influenced by the quality of the initial ingot but, in addition, it may be affected in other ways. Cracking and lamination must be avoided by inspection of etched slices and fracture tests at the "back end," and by ultrasonic inspection. Severe peripheral banding must also be avoided, for, although the normal pre-forging processes will generally eradicate this feature, very coarse peripheral structures lead to surface creasing and folding, and hence to excessive rectification and possibly rejection.

Pre-forging Processes. The pre-forging operations provide the key to the mechanical quality of the finished forging, for it is in this stage that the foundations of strength and ductility are laid. The pre-forging processes are designed in relation to the functional requirements of the component so that the strength of the forging is where the designer requires it.

The advances in pre-forging techniques have been largely an evolution from the simple upsetting operations used for the early pistons to the complicated multiple forging operations now conducted on large presses and hammers. The sequences of upsetting and drawing-out operations can now be admixed to confer a high measure of uniformity of mechanical properties in such diverse components as impellers, undercarriage components and spar forgings.

Although the forger now has the facilities and the knowledge to design the forging operations to a given component, this is of little value without a knowledge of the design requirements for that component. Perhaps the most significant advance in relation to the manufacture of forged aircraft components has been the closer consultation between the designer and the forger, whereby the requisite information is exchanged and each begins to understand the difficulties of the other and so can contribute more effectively to the solution of particular problems.

Die Forging Processes. Until the end of the Second World War the majority of die forgings were for aero-engines and usually were fully machined, although some structural forgings—particularly for undercarriages—were being made. Towards the end of the war, the airframe designer began to give serious consideration to aluminium-alloy die forgings; and since this time a new product—the airframe forging—has come into being. Illustrations of large modern forgings are presented in Figs. 1, 2 and 3.

Initially, airframe forgings were treated in the same way as

* *Research and Development Division of High Duty Alloys, Ltd.* *The author expresses thanks to the directors of that company for permission to publish this article, and to several of his colleagues who helped in preparing the material.*

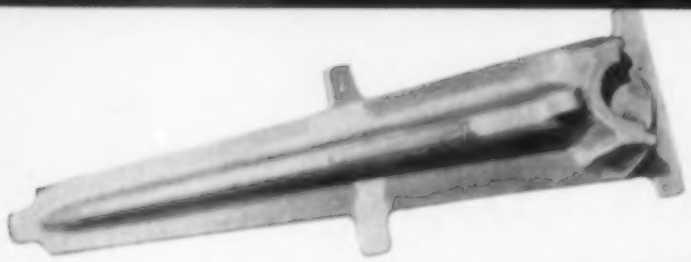


Fig. 1 (left) Undercarriage bearing beam forging in D.T.D.683, made on 18-ton drop stamp.

Fig. 3 (below) Wing rib fitting in D.T.D.683, from 12,000-ton press.

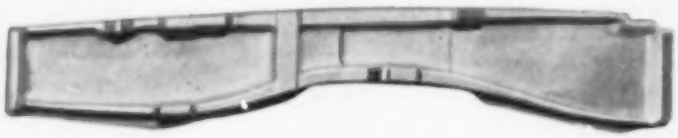
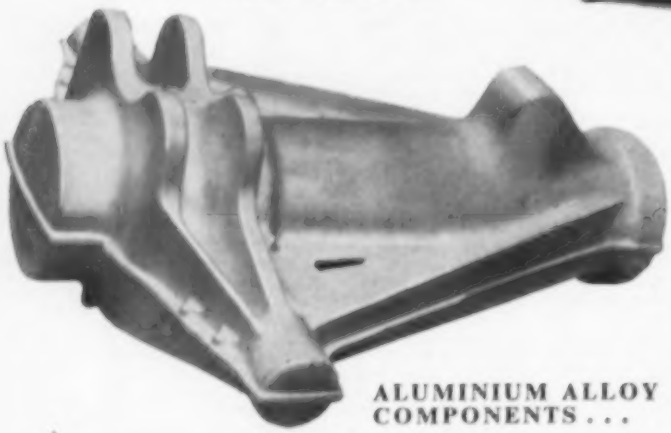


Fig. 2 (below) Undercarriage swivel housing in D.T.D.683, forged on 12,000-ton press.



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engine components, where the "as forged" surfaces would be fully machined before assembly. The airframe designer, however, was employing forgings not only for strength reasons but also to eliminate machining time. Consequently die forgings were used, in which much of the surface was merely pickled before use. The effect of this practice was two-fold—to cause a gradual increase in the inspection standards for airframe forgings and to bring about a re-examination of the die-forging process. Up to this time forgings had been largely made by the drop-stamping method where draft angles and tolerances generally were greater than the designer wished to accept. Attention naturally turned to press forging to meet this requirement, but the drop-stamping process was also improved by attention to the design of moulding and finishing dies.

At about the same time the aero-engine designer was voicing a new demand—for aluminium-alloy compressor-blade forgings finished to size in respect of the aerofoil, but with machining allowances on the fixing root (see Fig. 4). Much development work was necessary to reach this objective.

The requirements for compressor-blade forgings included fine dimensional tolerances and freedom from surface and other defects. The need to manufacture forgings to close limits naturally led to investigations into die-making methods, and much progress has been made in this direction. New machines for die sinking have been studied and installed, apparatus capable of measuring blades and dies with accuracy has been brought into use, and the heat treatment of die blocks has been improved. On the manufacturing side, methods of producing forged blades in large quantities to the new standards of quality have been evolved. In this development particular attention to quality has necessitated study of surface-preparation methods, pickling processes and inspection methods.

Not many years ago the standards of quality now observed in compressor blades would have been regarded as impracticable for forgings. To meet the conditions of service, involving high static and alternating stresses, it was evident that a new approach was necessary. It is interesting to observe that a parallel condition is now arising in respect of airframe and hydraulic forgings; many such forgings are receiving careful preparation for final inspection, including polishing and anodizing. Hydraulic cylinders have received particular study recently in an attempt to improve certain features, such as flash lines, and new methods of manufacture are under development. These methods are based on the closed-die technique in which the flash is eliminated; but the processes have not yet reached the stage of general application and can be used only for selected forgings.

Fig. 4. Compressor-blade forging in Hiduminium R.R.57, finished to size on aerofoil, but with machining allowances on the root.

Pre-heat-treatment Machining. It has been customary to perform machining operations on aluminium alloy forgings prior to heat treatment, but until recently the principles governing such machining have been related only to quenching efficiency. It was realized that thick masses would be characterized by reduced mechanical properties and consequently these were avoided as far as possible by machining. In the light of accumulated experience and recent investigations, however, it is evident that careful thought must be given to the pre-heat-treatment machining process. The form of the component at the quenching operation is closely linked with the order and pattern of the internal stress system which may be set up; the geometry of the component at the time of heat treatment must therefore be studied in order to avoid distortion (and even cracking in severe cases) during the final machining operations.

Heat Treatment. Most aluminium alloys require heat treatment to develop their mechanical properties. The process involves solution treatment at about 500 deg C and quenching, usually into water. This may be followed by age hardening at room temperature or precipitation hardening at temperatures up to about 250 deg C. All these temperatures must be accurately observed, and special furnaces and temperature controlling equipment have been developed for the purpose.

Certain aluminium alloys, specially designed for use at elevated temperatures, require heat treatment procedures which are in some degree unusual. The particular attributes of these alloys are fully developed by long-term solution treatment and, in the case of Hiduminium RR.57 and RR.257, by age hardening at 215 deg C. The latter treatment, applicable only to alloys of this type, promotes a lattice expansion conferring high stability and low internal stress on the component.

Internal stress in aluminium-alloy components arises during quenching when temperature gradients through the mass of metal cause corresponding differences in contraction. The final condition is far from simple, being a balanced system of stresses contained wholly within the component and independent of any outside force. In severe cases, the balance may be so fine that apparently insignificant factors, such as a slight change in temperature, can trigger disruption of the component. It is now realized that internal stress is responsible for a great many of the failures of aluminium-alloy components, occasionally in spite of the best-known practices being followed. Investigation of such cases has invariably led to a further advance in knowledge and has emphasized that the machining and heat-treatment operations are interrelated and often specific to a given component.

Action can usually be taken during heat treatment to ensure the minimum internal stress level, but this may be useless if extensive out-of-balance machining operations are likely to follow.

The most effective action which can be taken is to raise the temperature of the quench water, boiling water giving a surprising reduction in internal stress level. The highest level of internal stress results from quenching into cold water, and this condition is not greatly improved by raising the water temperature to about 70 deg C. Beyond 70 deg C there is a progressive reduction in stress level to that obtained by quenching in boiling water.

Quenching to obtain maximum reduction in internal stress naturally brings some penalties, and these are usually found in reduced mechanical properties. Some alloys are less sensitive in this respect than others and alloys of the types D.T.D.130A, D.T.D.731 and certain alloys conforming to D.T.D. 683 suffer relatively little. Alloys of the types D.T.D.364 and L.65, and alloys containing chromium, show severe loss in properties following quenching into hot or boiling water.

In the case of extrusions, considerable relief in internal stress may be obtained by stretching after quenching, but the majority of forgings are geometrically unsuited to the application of cold

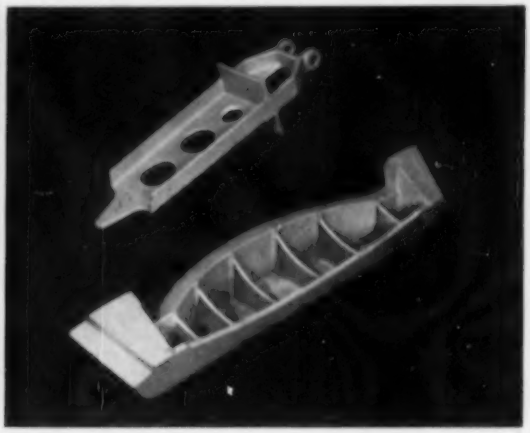


Fig. 5 (left) Helicopter gearbox, sand-cast in L.51. Fig. 6 (Right) Hinge rib fitting and windscreen fitting, die-cast in L.53.

plastic deformation. A few simple geometric shapes, such as cylinders, have been stress-relieved by upsetting by a pre-determined amount on a large press. The percentage upset, calculated from the stress-strain diagram for the alloy in the as-quenched condition, included elastic and plastic strain. The method is quite successful but is clearly limited in application; so for the majority of forgings full advantage must be taken of the benefits of hot-water quenching.

Inspection. The standards of inspection for airframe and engine components have steadily improved during the last two or three decades. Initially material quality was the criterion, but more recently surface quality has become almost equal in importance as the influence of minor surface imperfections on calculated performance has become more widely realized.

To meet the increasing standards of inspection extensive preparation is now employed. Forgings are carefully stage-inspected and finally may be polished, pickled and anodised to aid in the detection of defects. The chromic acid anodising process, because of its defect-revealing capabilities, has become established in the forge shop and is being widely applied.

The effort applied to produce modern light-alloy die forgings free from defects, together with the improved inspection methods accordingly required, has raised their quality to a very high level, necessitating careful handling throughout subsequent machining operations.

Testing. The routine release testing required by specification consists of tensile tests on forged bars and hardness tests on the forgings. The former test ensures only that the material complies with the specification and does not provide any information on the mechanical properties of the forgings. The latter test confirms that the forgings have been heat-treated. This type of testing, while being reasonable for release purposes, is not very informative to the designer, and there has grown up during recent years a method of "cut-up" testing from which design information is derived. This method requires that the "first-off" forging be heat-treated and tensile test pieces taken out at agreed locations. The results of these tests are expected to comply with mechanical properties previously agreed between the designer and the forger. Normally, a report on the "cut-up" examination is furnished to the designer for reference purposes.

In the course of this procedure, a considerable quantity of mechanical test results has been accumulated and has been statistically analysed to provide, for certain alloys, agreed minimum design properties which represent about 98 per cent expectancy for die forgings.

CASTINGS

Before and during the late war, most aircraft castings were made for use in engines and were founded in the alloys particularly suited to this purpose. There was little use of castings in the airframe, and such components as were made fulfilled unstressed applications, for which almost any alloy was suitable. The post-war years, however, have seen increasing use of the high-strength alloys to specifications L.53 and D.T.D.304 for the manufacture of structural castings such as flap brackets, levers and controls. The majority of these components are made as sand castings, although, when production quantities permit, die castings are often manufactured; in both cases the Class I inspectional standards are met.

Aircraft castings are made chiefly as sand and die castings, both of which can meet in full the requirements of the official classification system. Some components are made as pressure die castings, but at present these are limited to Class III (unstressed) applications.

In reviewing the progress that has been made in the manufacture of castings for aircraft, it is convenient to consider separately the three manufacturing methods mentioned above.

Sand Castings. It was for long a tradition that sand castings should have wide and variable limits, by reason of "uncontrollable" factors associated with the making and assembly of the several parts of a sand mould. Unpredictable quality, as indicated by variations in soundness and in tensile properties necessitating intensive inspection, was regarded as normal. In modern light-alloy sand castings, however, these shortcomings have in a large measure been eradicated.

Many improvements have contributed to better quality. By investigation of castings, using all available techniques of examination and inspection, considerable advances have been made in the methods of pouring and feeding. At the same time a better understanding of the causes of porosity has been obtained and, as a result, greater soundness can be ensured by careful control of pouring temperatures and by better chilling methods. Studies have also been made of moulding sands and binding agents, from which modern sand-control methods, ensuring consistency and reliability, have been introduced and are used in most up-to-date foundries.

In parallel with advancement in the quality of castings, work has also been done to provide greater accuracy of dimensions. The process known as "shell moulding" has been applied to the manufacture of cores, providing closer limits and improved surface-finish. The carbon-dioxide process is also finding considerable application in the production of cores. This method provides a core which is immediately stable and usable; and, because of the consequent greatly reduced risk of sagging, improved tolerances on wall thicknesses are obtained. These two methods of core making have greatly assisted the founder in obtaining better dimensional and weight control and will find increasing application in the manufacture of sand castings for aircraft. A typical modern sand casting is illustrated in Fig. 5.

These improvements in the techniques of making castings, however, can be seriously offset by the use of inferior or unsuitable pattern equipment. Wooden patterns are satisfactory for prototype manufacture where small numbers only are required; but they clearly cannot withstand, without early deterioration, the more intensive use arising in production. For this purpose accurate and well-made metal patterns are essential if the benefits of progress are to be ensured. It will be appreciated that metal patterns are expensive equipment and, as they are a charge on the user, their provision often becomes an economic decision. The comments above, however, cannot be too strongly emphasized, for the use of unsuitable patterns may be false economy.

Die Castings. There is an increasing tendency for prototype components, originally made as sand castings, to be manufactured in production as die castings. This has been encouraged by the developments which have taken place in the die casting process whereby much more complicated shapes may now be produced with high accuracy and good quality. The advances made in this field are mainly in die design and in production methods.

The limitations of the die casting process lay originally in coring. Cores had necessarily to be extremely simple, although more intricate designs were possible where sand cores could be used. The combination of die and sand core, however, was not a very happy one, since the fine, dense structure characteristic of a die casting could not be ensured. The structure of the casting would certainly be finer than if it were made wholly in sand, but there was danger of porosity and coarsening adjacent to the sand surface. This condition was obviously not satisfactory to the founder, who has accordingly devoted much thought to improved die design. The work on die development was intensified during and since the last war and considerable progress has been made. Dies having collapsible cores, permitting considerable intricacy in design, are now commonplace in the foundry and are finding wide application in the aircraft field.

The range of components which can be made as die castings has been further extended by the use of shell-moulded cores. These cores, although moulded in sand, do not have the disadvantages of the solid sand core and at the same time have several advantages not possessed by metal cores. With shell

ALUMINIUM ALLOY COMPONENTS . . .

moulded cores, there is much greater scope for producing intricate designs, and without loss in quality, accuracy or finish. It is possible that shell-moulded cores will provide improved surface quality, as compared with a collapsible core, since there will be no witness of the split-lines inevitable with the latter.

Dies are now designed for rapid production, careful attention being paid to handling, stripping and ease of fettling.

Illustrations of two die-cast aircraft fittings are shown in Fig. 6.

The conversion of sand-cast components to die castings has been furthered by good collaboration between designer and founder. This procedure enables a component to be designed to fulfil an aircraft function and at the same time to be suitable for manufacture as a die casting. Moreover, the problems of the designer and the founder become mutually appreciated, with considerable benefit to the quality of the component.

Pressure Die Casting. Until recently, the aircraft engineer has made little use of pressure die castings but there is now an increasing tendency to employ them for unstressed applications. Instrument cases and similar fittings are examples where the particular virtues of the pressure die casting process have been used to advantage.

Inspection. The employment of castings for stressed applications in aircraft is dependent upon searching inspection. This relies primarily on the radiographic method, which has become established as the approved means of quality assesament. For many years, the radiographic inspection of castings was mainly a matter for the founder, who developed inspection techniques which, while checking castings for quality, provided information on which processes and methods were developed. Recently, however, the radiographic technique has become increasingly the concern of the inspecting authority and the emphasis has moved to the specific rather than the general use.

Surface defects are as significant in respect of performance as are internal defects. The radiographic method does not reveal these, and consequently other processes have been devised. Among the most successful are the dye penetrant processes, of which effective use is now being made.

SUMMARY

The past thirty years have seen outstanding advances in the techniques of manufacture of aluminium alloy forgings and castings for use in aircraft. There is considerable evidence, moreover, that this progress will be maintained in the future. In the field of forgings, the capabilities of the large forging press are being explored and experience is rapidly being accumulated of die design, mechanical properties and component handling. The production of flashless forgings for special applications is also being pursued and research on many of the problems associated with forging is continually proceeding. Developments in the foundry are also taking place in the directions of improved quality and accuracy. The search for better moulding materials and methods, which produced such processes as shell moulding and the carbon dioxide method, continues. Further development work is also proceeding in the improvement in the die casting and pressure die casting processes.

The British Light-alloy Industry

A Review of Enterprise and Achievement

THE "Aluminium 1955" Exhibition, now concluding in London—a brief review appears on page 813—has focussed attention on an industry whose products may be said, without exaggeration, to have made modern aircraft possible. Some of its firms are almost as old as commercial aluminium itself; others have developed in recent years; but an unusually high degree of technical ability and initiative is common to all of them. In the following pages we present brief reviews of the histories and products of the majority of the companies concerned with producing light alloys, or finished or part-finished components in these materials. The emphasis on this particular occasion is on aluminium alloys rather than on those of magnesium or titanium.

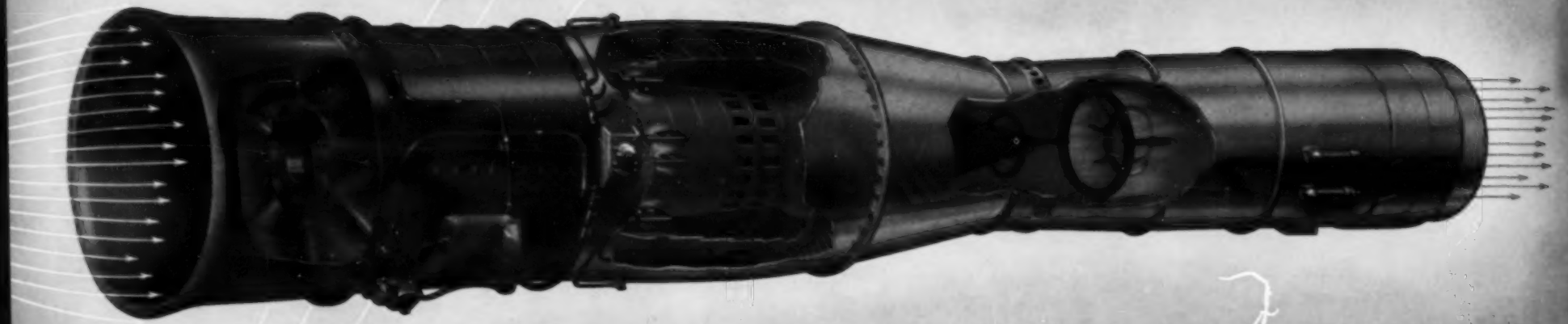
ALMIN, LTD. Though a large and still expanding organization, the Almin Group is comparatively young. It was formed at the end of the war and, with an eye to new civilian markets, a policy was adopted of not only producing aluminium in ingot form, together with castings, forgings, tubes and extrusions, but also of manufacturing a considerable variety of finished commercial articles.

At least two of the Almin companies have a close connection with the aircraft industry. *Renfrew Foundries, Ltd.*, was formed jointly by Almin and Rolls-Royce for the peace-time operation of the war-time foundries of the latter company at Hillington, Glasgow. To the sand and gravity divisions, already forming one of the largest aluminium foundry units in the country, there was added a pressure die casting unit equipped with machines to the design of the American Doehler-Jarvis Corporation, of whom Renfrew Foundries are the United Kingdom licensees. Not surprisingly, gas-turbine and piston-engine castings form a considerable volume of the output.

Then there is *Aero Controls, Ltd.*, of Northampton, well known in the industry for many years past as manufacturers of flying and engine controls and associated mechanisms; this company has recently been acquired by the Almin Group. An important addition to the range of products is a structural system, utilizing standard aluminium parts from which a wide variety of maintenance stagings and similar equipment can be quickly

A magnificent example of structural engineering in aluminium alloys: the Comet hangar at the de Havilland airfield at Hatfield; the portal frames span 217ft and the hangar is 330ft long by 45ft high. The main structure is of HE10 extrusions with side sheeting of corrugated NS3 (architect, James M. Monro and Sons; designers and constructors, S.M.D. Engineers, Ltd.; photograph by courtesy of "The Aluminium Courier," journal of the Aluminium Development Association).

Specialists in Gas Turbine Combustion Components



BRIGGS MOTOR BODIES LIMITED

SWAYTHLING, SOUTHAMPTON

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- **Flame Tubes**
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- **Cooling Air Manifolds**
- **Annular Combustion Chambers (complete)**
- **Combustion Chamber Heat Shrouds**
- **Stator Conical Supports**
- **Outlet Branch Extension Units**
- **Bearing Housing Units**
- **Bearing Cover Units**
- **Fire Wall Units**
- **Oil Tank Units**
- **Jet Pipe Assemblies**

Flight, 10 June 1955

NORAL ALLOYS

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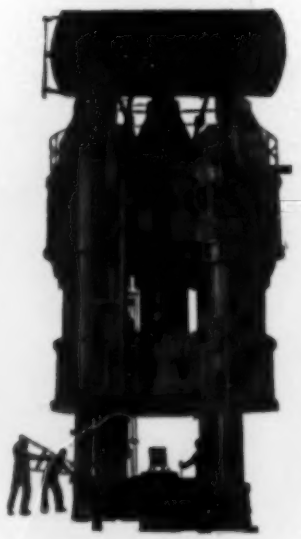


THE BRITISH LIGHT-ALLOY INDUSTRY . . .

assembled, and as easily dismantled for re-erection in new forms. A 30ft aircraft servicing tower constructed by this method was shown at the Aluminium Exhibition. *Multiform Structures, Ltd.*, are an Almin company specializing in servicing and access equipment of this type, which is being marketed under the name of "Basix".

Wrought aluminium alloys, including extruded bars and sections, tube and forgings, are produced by *Southern Forge, Ltd.*, at Langley, Bucks. The company has been particularly concerned with the development of new markets of extruded and forged products through an engineering development department maintained to give advice on the design of wrought aluminium components. It has met with considerable success in the introduction of special extruded sections for aircraft and road transport vehicles and for various industrial applications. High-quality, close-to-form forgings are another speciality.

Warwick Production Co., Ltd., is the principal unit of the Group engaged in manufacturing finished aluminium products. It claims the widest ranges of press tools for the deep drawing of aluminium in the country and is equipped for assembly by Argon-arc welding, and for anodising and other finishing processes. Aircraft sub-assemblies are among this company's wide variety of products.

International Alloys, Ltd., is an old-established member of this new group; in the early 1930s it pioneered the production of high-quality aluminium ingots by re-smelting and refining of scrap. Vigilant laboratory control soon overcame prejudices against secondary alloys, which were soon—when war broke out in 1939—to prove vital materials. Today, more than a third of all the aluminium used in this country is in the form of secondary alloys. International Alloys have factories at Aylesbury, Bucks, and Birmingham.

Most of the research for the Almin Group is undertaken by the *Fulmer Research Institute* on a sponsorship basis.

Almin, Ltd.—the name stands for "Associated Light Metal Industries"—have their head offices at Stoke Poges, Bucks.

BIRMETALS, LTD., was formed in 1936, and the Woodgate Works (Quinton, Birmingham 32) were built for the production of wrought forms of aluminium and magnesium alloys. Before this the only wrought alloys made by the (now) Birmid Group were the "Birmabright" series. Birmetals undertook the production of the "Birmabright" alloys (for their associate company, Birmabright, Ltd., as well as the strong alloys of the copper-bearing type, medium-strength alloys, and the various magnesium-base compositions.

Production began at Woodgate Works in February 1938, mainly on the "Birmabright" alloys, following the success of these materials for marine and other applications. Aluminium alloys for marine work had previously been proved by the company's boat yard—Birmal Boats—started in 1930 for the building of light-alloy boats but later closed down when "Birmabright" had been firmly established as a practical material for boat building.

To keep pace with the growing demand for light alloys during the war, additional units of the Birmetals factory were brought into production in 1940, 1942 and 1943. Aircraft materials formed the bulk of the output, including the copper-bearing type, aluminium/magnesium/silicide and the aluminium-magnesium (Birmabright) types, and also the various magnesium-base alloys.

Wrought products which are manufactured cover sheet, strip, extruded sections, rods and bars, drawn and extruded tubes, and drawn wire. In 1947 a new sheet and wide strip rolling plant was installed, and at the present time the working plant occupies an area of some 25 acres.

In addition to production, experimental and development work has been carried out continuously and has included the introduction and development in this country of the automatic Argon-arc welding process. Experimental production work has also been undertaken in connection with such special projects as guided missiles.

BIRMINGHAM ALUMINIUM CASTING (1903) CO., LTD. This firm—"Birmal" for short—has a strong claim to be represented in any historical celebration associated with aluminium, for two years ago it celebrated its 50th anniversary. Even before its registration in 1903 under its present title the firm was working the light metal—in fact, it was doing a considerable amount of casting, much of it for the infant automobile industry, as early as 1901.

Birmal were one of the earliest firms to investigate the possibilities of die-casting, and can claim to have pioneered the die-cast aluminium piston. This was before the First World War, in which the company produced vast quantities of aero-engine components, Lewis-gun parts and—to a peak rate of a million a month—shell fuses.

In 1920 the company amalgamated with the Midland Motor Cylinder Co., thus establishing the basis of an organization that was later to be known as Birmid Industries, Ltd. Nine years later the business of Sterling Metals, Ltd., was acquired. A member of the Birmid group today (and appearing in this review under its own heading) Sterling Metals at that time were able to open up important new possibilities for the parent company, since they held a licence from F. A. Hughes and Co., Ltd., for the production of magnesium Elektron castings.

In 1929 the famous "Birmabright" aluminium alloy was evolved, with its high anti-corrosion properties. This material was referred to in the previous section, dealing with Birmetals, Ltd.

On the outbreak of war in 1939 Birmal turned over production entirely to aircraft-component castings and to munitions. The late Mr. Percy Pritchard (joint managing director) was asked to institute the Castings Section of the Light Alloy Control and at the request of the Government he also established the Light Metal Founders' Association. He introduced a new alloy (which he had patented in May, 1939) as a general-purpose casting metal, which became known as D.T.D. 424 and later as L.M.4. This was used without royalty fees by the entire industry.

During the war the firm's output of complex aircraft castings rose to a *tonnage* of 1,000 per month. A factory erected at Stourbridge and managed by Birmal achieved a million-a-month output of magnesium incendiary bombs.

Today, aircraft work continues to form a substantial part of the company's work, current contracts for aluminium castings including gas-turbine compressor casings, diffuser and diffuser-shroud castings, hot air manifolds, and oil-pump bodies; many airframe and engine castings are also being made in magnesium.

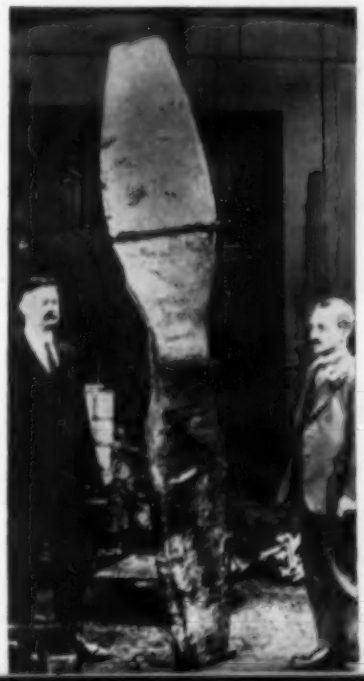
The Birmal headquarters are at Smethwick, Birmingham, 40, and the Board of directors consists of Lord Burghley, K.C.M.G. (chairman), E. Player and J. W. Berry (joint managing directors), C. E. Keey, W. N. Sherlock, G. A. Rider, W. J. Price and H. Peters.

JAMES BOOTH AND CO., LTD. Familiar by name to millions outside the aircraft industry, Duralumin has suffered the fate of most "household words" in that it has come to be spelt, as often as not, with a small letter. *Flight*, which likes to respect registered trade names, usually contrives to remember the capital "D"—though we would now be reluctant to put so familiar a word in quotation marks, as might be demanded.

The name has been associated with that of James Booth since the early days of World War I. The phenomenon of age-hardening, involving the employment of copper and magnesium as alloying constituents, had been discovered by Wilm in Germany at the turn of the century, and this was the foundation of the Duralumin series of strong light alloys. The Germans developed these materials commercially, and subsequently sold the world rights outside Germany to Vickers, Ltd. In 1910 the English company secured the services of a brilliant young metallurgist, Horace William Clarke, and encouraged him to explore the possibilities of the new alloys to the fullest extent.

For the next five years, in collaboration with Mr. H. B. Weeks, Dr. Clarke investigated the production of Duralumin in sheet, rods, extrusions and forgings; new methods of melting and alloying were evolved; and a series of critical and sometimes dangerous experiments in large-scale salt-bath treatment were conducted, with valuable results.

In 1915 Vickers, Ltd., acquired control of an old-established Birmingham business which had been founded by James Booth, and from this they formed a new company under the title of James Booth and Co. (1915), Ltd. Under the supervision of Dr. Clarke, a small experimental section of the works, with one extrusion press, rapidly expanded into a factory covering several acres, given over entirely to the production of Duralumin components, mainly for aircraft. Throughout the First World War, the work of Dr. Clarke and his staff made it pos-



This Duralumin forging, for a Supermarine S.6 Schneider Trophy airscrew, is believed to have been the largest made in strong light alloys up to 1932 (James Booth and Co., Ltd.).

THE BRITISH LIGHT-ALLOY INDUSTRY . . .

sible for such work to be kept abreast of German developments.

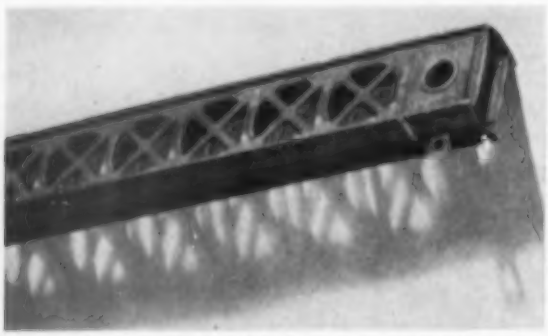
Thousands of girders and other structural parts for the new "R" series of airships were made in Duralumin, crankcases for such famous post-war products as the Bristol Jupiter engine were cast in it, as were pistons, there was a growing output of wire, rivets, sheet, strip, tube, rod and special sections; the well-remembered Fairey-Reed metal airscrew, too, was produced in thousands.

In the early 1920s Short Bros. built their pioneer all-metal Silver Streak, and all the alloys used in its construction were supplied by James Booth.

In 1922 Dr. Clarke was appointed managing director of the company, a post in which he continued when, in 1928, Vickers sold their interest and the firm was converted into a public company; he is today chairman and managing director.

As in the First World War, so in the second: the firm of James Booth undertook a tremendous volume of work, principally for the aircraft-production effort. A 12,000-ton forging press had been installed in 1937—as a private venture—and with its aid more than 300,000 airscrew-blade forgings were made during the war years. Later the company installed and operated a similar press for the Government, who disposed of it after the war.

Equipment of this kind has enabled James Booth and Co. to accumulate exceptional experience in the manufacture of large forgings for undercarriages, spars and other major aircraft components, though their light-alloy work for the industry is by no means confined to such products. For extrusions, they claim the largest capacity in the country in that they have more presses than any other company, including two 5,000-ton units. They also have the largest drawbench in the country, and can produce tubes from the smallest size up to 17in o.d. In addition, the company produce sheet, strip and plate in aluminium and magnesium alloys and wire in aluminium alloys. Apart from this, their activities extend to copper and brass, materials which, however, are outside the scope of this review.



A Duralumin strut made entirely by hand at the works of James Booth and Co. in 1917. Designed by Professor Lee of Birmingham University for airship use, this type of structural member was later modified for use in heavier-than-air aircraft.

The board of James Booth and Co., Ltd., consists of Horace W. Clarke, D.Sc., chairman and managing director; Denis H. H. Clarke, M.A., A.M.I.Mech.E., deputy managing director; R. W. Cooper, J.P.; The Hon. Geoffrey Cunliffe; Sir Bernard D. F. Docker, K.B.E., J.P.; Noel H. Docker; Sir Patrick J. H. Hannon; Edward Joynson, M.B.E.; and Sir James Reid Young, C.A. F.C.I.S.

THE BRITISH ALUMINIUM CO., LTD. The development and expansion of the aluminium industry owes much—far more than is normally realized—to the demands of the two world wars. By a tremendous effort for the second war, the production capacity of the country was expanded four-fold to a peak output of all semi-fabricated forms exceeding 270,000 tons a year; and the British Aluminium Co. made a large and vital contribution to this effort.

Inseparable from the history of aluminium is the story of the company's expansion. Its founders, who met in 1894, with Lord Kelvin as their scientific adviser, set out to control as far as possible all stages in the isolation of aluminium from the raw material; by acquiring the rights in these processes, the company became one of the pioneers of the world's aluminium industry. Aluminium itself forms about eight per cent of the earth's crust—but it occurs only in combined forms. A number of silicates, clays and rocks contain the metal, but only bauxite, which carries a high proportion of the hydrated oxide, is an economical source for large-scale production.

The reduction of aluminium calls for electric power in enormous quantities. This is the power house of the Lochaber, Fort William, works of the British Aluminium Co.; the 12 water turbines have an output approaching 10,000 h.p. each.

A number of early processes for the separation were introduced, but by 1893 all were put out of business by the Hall-Héroult method: this was further developed by an Austrian chemist, Karl Joseph Bayer, and his process is still in use today. Using the Bayer patents for alumina and those of Héroult for the reduction process, the British Aluminium Company started operations. An alumina works at Larne Harbour in Northern Ireland, a carbon electrode plant at Greenock on the Clyde, and a reduction works at Foyers on the southern shore of Loch Ness in Scotland were set up, and in 1896 the first metal was produced.

The comparatively high cost of aluminium is easily appreciated: to produce a ton of the metal requires about four tons of the ore. Further, the separation involves almost two tons of coal, a fifth of a ton of caustic soda, half a ton of carbon and 20,000 units of electricity. Indeed, a cheap source of electricity is the most important factor, and for this reason alone the British Aluminium Company have all their reduction factories in the Highlands, where they have been able to harness local water supplies for the operation of hydro-electric generators. Low voltage and high amperage are used in the furnaces to provide the heat necessary to keep the alumina and cryolite (a double fluoride of aluminium and sodium which melts to form a clear liquid through which the current can pass) maintained in the molten state. At the same time the alumina is reduced, liberating oxygen, which combines with the carbon of the anode to form carbon dioxide. Molten aluminium sinks to the bottom of the furnace and is withdrawn at intervals.

Aluminium requirements for the aircraft industry in particular are heat-treated strong alloy sheets. To this end, one of the most modern rolling mills in the world was constructed at Falkirk. Capable of rolling sheet and strip from large slabs up to two and a half tons in weight, it began production in June 1944, and was bought by the company from the Government in 1946. Extensive reconstruction was then carried out, placing Falkirk among the most versatile and efficient rolling-mills in this country; it is today capable of producing up to 60,000 tons a year of rolled products.

Originally, in 1896, the furnaces at Foyers were designed for currents of 8,000 amp; later, experiments carried out at the Kinlochleven reduction works led to increases in furnace size in stages, and up to 40,000 amp were used; and more recently, furnaces taking a current of 100,000 amp have been installed and are in regular use.

The company now has eleven works, employing nearly 10,000 people, and important facilities for raw materials and aluminium production and fabrication in many parts of the world. In addition to its London head office it has eight branch sales offices and subsidiary selling companies and agencies in the principal countries of the world. The success of the company is due in a considerable measure to Mr. Robert William Cooper, M.C., who was director for 43 years, from 1909 until his retirement in 1952.

The research activities of the company have increased as pro-

duction facilities expanded. In direct contrast to white-hot metal and giant turbines is the laboratory at Chalfont Park in Buckinghamshire: there, in the quiet of an adapted country mansion standing in forty acres of grounds, technicians and analysts are able to work for the further development of the company's production.

HIGH DUTY ALLOYS, LTD. In 1928-29 Rolls-Royce, Ltd., patented their famous R.R. series of aluminium alloys, and High Duty Alloys, Ltd., who had already co-operated with the Derby company in evolving these materials, were granted an exclusive licence for the manufacture of the R.R. series, the commercial possibilities of which had been realized.

Collaboration and research progressed, and many new alloys have been evolved from the originals, which have fulfilled the increased demands of higher performance in aircraft. Such a material, developed in 1936-37, was Hiduminium R.R.77, having the highest strength/weight ratio of all in the wrought form. This was immediately adopted for extensive use in airframe construction. A modification—Hiduminium R.R.88—was introduced, so that two high-strength alloys were available—R.R.77 for forgings and pressings, and R.R.88 for extrusions. The further demands of the aircraft industry gave tremendous impetus and incentive to development, and there followed close collaboration—which still exists today—between High Duty Alloys and the leading aircraft constructors.

The company claim to be the first to install crystallographic X-ray apparatus, for determining lock-up internal stresses during both fabrication and subsequent heat treatment. The ability to control these stresses to a known figure greatly assists in the manufacture of such components as crankcases, and

Under the 12,000-ton forging press of High Duty Alloys' Redditch works; lubricating the die during forging of a major component for an Armstrong Siddeley Sapphire turbojet.

rotors. The X-ray equipment was first used in the production of aero engine pistons as light alloy forgings.

Considerable foresight was shown by the company before World War II in anticipating the tremendous demand that would be made upon the aircraft industry in the event of hostilities. New factories were built: a forging division at Redditch, and an extrusion division at Distington were opened, equipped with the most modern plant and equipment available. Each division had its own self-contained research laboratories; also at this time, further expansion was made possible by the opening of extensive new laboratories to serve the whole organization.

The requirements of war set numerous problems. Typical was the production of the forged impellers for Sir Frank Whittle's early experimental gas turbines and for the engines which subsequently went into service. There followed the development of compressor blades, for axial-flow gas turbines, as close-to-form forgings. At the time this was a highly progressive step which had not previously been considered possible, and it is estimated that, since 1940, when blades were produced for the early Metrovick turbojets, over twenty million blades of all types have been produced by the company's forging division.

Following the war, the company reverted to the original policy of assisting aircraft designers in the use of alloys, fabrication methods being evolved in practically every branch of the industry.

From the four original R.R. alloys many new ones have been developed, each having its own distinctive characteristics to meet practically any application. The latest is Hiduminium 100 (S.A.P.), the elevated temperature and corrosion-resisting properties of which are claimed to be far in advance of those of contemporary materials.

High Duty Alloys, a member of the Hawker Siddeley Group, at present employs some 6,000 people.

I.C.I. METALS DIVISION, which through its member firms has a history of a century-and-a-half in the wrought non-ferrous industry, was quick to realize the potentialities of light alloys. Its accumulated knowledge and experience of manufacturing techniques was such that, at the beginning of the 1939-45 war, the Government asked the division to build and run the Ministry of Aircraft Production's new aluminium-alloy plant at Waunarlwydd, near Swansea.

At that time the wrought-aluminium industry, still in its infancy, was quite new to South Wales. It was, therefore, no easy assignment when the Waunarlwydd factory was expected to produce aluminium sheets and extrusions of impeccable quality, needed in desperate haste. That it was able to do so, say I.C.I., can be attributed to two factors—the skill and experience of the division's technicians and supervisors, and the adaptability and capacity for hard work of local labour.

Shortly after the war ended, I.C.I. demonstrated its faith in the future of light alloys by buying the factory from the Government. Since then, the works have been extended and improved by the addition of still-more-modern plant. Today their output of aluminium and aluminium alloys, in sheet, strip, plate, bars, sections, tubes and wire, finds many outlets, particularly in building and transport applications. Under the trade names "Kynal" and "Kynalcore," the factory's products are widely used in the aircraft industry for aircraft structures, engine components, heat-exchanger and electrical units, fuel systems and various other services.

KENT ALLOYS, LTD., was founded in March 1939 by Short Bros., Ltd., (who were then at Rochester) to manufacture aluminium castings for their famous Sunderland flying-boats and other aircraft. During the war vast numbers of aluminium castings and parts were produced for such well-known types as the Mosquito, Stirling and Lancaster.

Kent Alloys have since grown and developed; they are now one of the Birfield Group of companies. In addition to aircraft castings their Temple Manor works at Rochester now produces a wide variety of castings in aluminium and other alloys for the commercial market, not only by the sand-casting method but also by the gravity-die-casting and shell-moulding processes.

Close association with the aircraft industry has resulted in a high standard of inspection and laboratory control; use is made of radiographical examination by both X-rays and gamma-rays. Works equipment includes a range of heat-treatment furnaces specially designed for processing aluminium alloys, and there is also anodising plant, Argon-arc welding equipment, and other processing installations. Well-equipped machine shops enable the company to machine their own castings; they also manufacture complete assemblies, so that comprehensive services are available to customers.

Directors and senior executives are as follows: H. E. Hill, chairman; C. G. T. Hyslop, director; C. E. Lovelace, director and general manager; W. D. Mendham, director and chief metallurgist; D. L. Roome, director; E. Walker, sales director; M. F. Mansell, works manager; C. W. Farrow, chief inspector; R. O. Couchman, chief radiologist.

NORTHERN ALUMINIUM CO., LTD., in its early days, functioned exclusively as importers of aluminium from North America. In 1926 they entered the manufacturing field by acquiring an interest in a small foundry which later formed the nucleus of the present works at Birmingham. Frequent extensions were made during the next decade, until further expansion during the war brought about a monthly production figure of 400 tons of forgings and 150 tons of castings.

Modernization since the war has resulted in an increase of over two-thirds in the output of the gravity-die-casting departments. In addition, a separate foundry for the production of pistons is also housed on the site; it has a daily output of 10,000 lb. All castings used in aircraft are subject to A.I.D. inspection and are given an X-ray examination before leaving the works.

Forgings are produced in considerable variety and include airscrew blades, stressed airframe parts, and undercarriage components. Advances in forging technique during and since the war have made possible the production of forged components to close dimensional tolerances.

Banbury Works. Three years after the opening of the Birmingham plant, the company laid the foundations of its Banbury works on a 93-acre site. In 1934 strong alloy sheet for civil and military aircraft represented little more than one-tenth of the Banbury works output; by 1939 it was more than 80 per cent and in the peak war year of 1943 was almost 100 per cent.

In 1935, also at Banbury, the first plant of its kind was built

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for the manufacture of Alpaste—the pigment for aluminium paints and printing inks.

In 1938 a new sheet-mill bay was built and equipped with machinery which facilitated the rolling of strip almost twice as wide as that previously produced; and the economic rolling of wider strip was made possible by the company's introduction into Britain of the continuous casting process in 1936.

When war broke out the works was excellently equipped to supply rolled and extruded products for aircraft, and in 1939 it accounted for 8,000 tons of sheet and strip and 4,000 tons of extrusions. By 1943 the output of the sheet mill had risen to 19,000 tons and the extrusion department to 11,000 tons.

In more recent years the works has provided, among its aircraft products, extra-large sheets to specially close tolerances for the Comet, Britannia, and many other well-known types. Today, the works is undergoing a modernization programme and the incorporation of the latest equipment is expected to increase output of sheet and strip by several hundred tons annually.

The Rogerstone Works. In early 1939, the Air Ministry chose Rogerstone, Monmouthshire, as the site for the erection of a small plant for the production of light-alloy sheet and extrusions, and Northern Aluminium were selected to design, erect and operate it. The works was originally intended to have a monthly output of 500 tons of sheet and 300 tons of extrusions, but when war broke out it was immediately decided to treble the output target. Expansion continued throughout the war, and by the end of 1943 the scheduled output had been increased to five times the original target, making the plant the biggest of its kind in the country.

By 1944 six extrusion presses had been installed in the main works and were in full production. On these was being produced an immense variety of aircraft sections, notable among them being the tubular Spitfire spar-booms, 40,000 of which were extruded, then anodised in a specially built plant.

Meanwhile, a new works was rapidly growing up on another part of the site. This, known as the West Works, had its origin in a department created in 1940, at the order of Lord Beaverbrook, for sorting and re-smelting holloware—i.e., "pots and pans"—collected in response to his nation-wide appeal and also for recovering aluminium from wrecked aircraft. Soon new buildings were required, owing to the continual expansion of the original department and the creation of others.

In June 1946 Northern Aluminium Company acquired the plant on a permanent basis, and in 1950 a continuous strip mill was opened. It was planned for an annual production of 50,000 tons, and provision has been made for trebling this output.

Among the principal aviation products fabricated by Northern today is a wide range of strong alloy sheet and sections, castings, and forgings.

The 8,000-ton extrusion press at Rogerstone was utilized, and the technical ingenuity of the extrusion engineers was taxed, to supply the 23ft-long main spar for the Comet 3. With a weight of 1,100 lb, this was the largest and heaviest extruded section produced in this country for aircraft, and was made from Noral C77S (D.T.D.363). Spar sections are also being produced for four other important machines, the Vulcan, Canberra, Beverley and Britannia.

Northern has recently produced, for the aircraft industry, some of the biggest strong-alloy plate yet made in this country. The company specializes also in the production of forged aluminium airscrew blades, and at the Birmingham works a 45,000-lb hammer is used in their manufacture. Airscrew aircraft on which these blades are used are the Viscount, Hastings, Shackleton, Princess, Prentice and Balliol. Noral die-forgings are used in the D.H.110, Venom, Heron and Vampire, while in these and a number of other types Noral castings are also to be found.

Northern Aluminium is a member of the Aluminium, Ltd., group of companies. In addition to the three works there are six area sales offices. At Banbury also are situated the sales development division and Aluminium Laboratories, Ltd.—an associated research company.

STERLING METALS, LTD., of Coventry—established in 1907 for the production of aluminium sand castings—were one of the very early entrants in the light-alloy founding industry. The company originally employed 20 people, and, though activities additional to those in the aluminium field have been developed, it is indicative of the organization's progress that the total number employed is now 2,500.

Insofar as aluminium castings are concerned, Sterling Metals today produce sand and precision castings, together with gravity die castings, and varying degrees of mechanization are employed to suit the type of production involved. The very large amount of work undertaken for the aircraft industry, covering both engine and airframe castings, has made necessary the installation of an extensive range of X-ray units to fulfil the rigid inspection requirements demanded. In like manner, much modern laboratory and inspection equipment is available to facilitate examination of castings before despatch.

Research and development work, say Sterling, is always in progress to maintain the high quality of their products, and the comparatively recent introduction of plaster, shell-moulding and CO_2 techniques has been carefully studied; these processes are used wherever it is apparent that improved quality and other advantages will accrue.

Whilst a large part of the production of the Sterling light-alloy foundries is devoted to the aircraft industry, practically every field of engineering is served and especially the automobile, tractor and heavy-vehicle industries.

The Board of directors of Sterling Metals, Ltd., consists of Lord Burghley, K.C.M.G.; Maj. C. J. P. Ball, D.S.O., M.C.; E. Player; H. Player; W. J. Sully; and F. Carpenter.

J. STONE AND CO. (CHARLTON), LTD. The firm of J. Stone was founded in 1831 by Josiah Stone, the factory in those days consisting of a small foundry and workshop in High Street, Deptford, at the side of the old Greenwich Railway. The primary manufactures were manual fire engines, pumps, ships' fittings, copper nails and rivets. In 1882, the works were transferred to larger premises, which today form a small section of an extensive factory at Deptford.

In 1916 the company acquired thirty acres of land at Charlton and erected foundries there to meet the increasing call for non-ferrous castings. In 1926 a gravity die foundry was put up at Charlton, and by 1934 the demand for aluminium alloy castings necessitated the erection of an aluminium foundry on the Charlton site. Large new foundries were put up in 1943 to meet wartime light-alloy requirements; extensively mechanized, they were fully equipped with the most modern plant available.

In 1951, the decision was taken to operate the Charlton and Deptford Works as two separate companies. J. Stone and Co. (Charlton), Ltd., was therefore formed to operate the Charlton Works, which embraced the main foundry production of the "Stone" Group and now covers aluminium alloys, magnesium alloys and yellow metals, by sand casting and gravity die casting. Various precision casting processes, including shell moulding, are now also being used.

In 1953, production capacity for aluminium castings was further increased by the acquisition of foundry premises at Gravesend, which were speedily converted to give a substantial addition to the Charlton output.

The light-alloy sand foundries, at both Charlton and Gravesend, include large machine-moulding sections, and the latest machine—installed last year at Charlton—is capable of moulding castings up to 6ft 6in long and 4ft wide. The floor moulding shops have produced castings weighing more than two tons each, whilst the longest aluminium castings produced were a series of aircraft wing-jig components 18ft long.

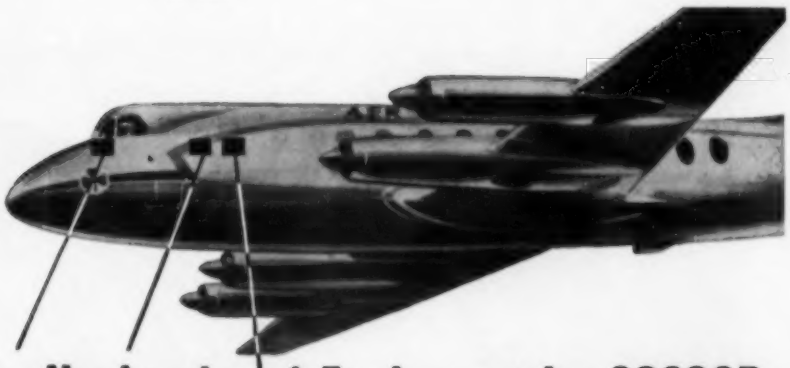
Both the sand and die foundries produce an astonishingly diverse range of light-alloy castings, including many complex components in high-strength alloys for the aircraft industry, as well as many more commercial applications. In line with modern practice, the foundry is equipped with X-ray facilities, consisting of nine X-ray plants and radio-active isotopes. This equipment is used not only for routine inspection of Class I and II aircraft components but also for the development of foundry techniques for other applications.

It has always been the company's policy to maintain the maximum possible effort in the field of basic research. In 1950 the metallurgical laboratories were transferred to a new building, specially designed for the purpose, at the Charlton works. The "Ceralumin" range of aluminium alloys were developed in these laboratories, and the latest of this range, Ceralumin 21, has recently proved its worth for high-temperature applications in the cartridge starters designed and manufactured by Rotax, Ltd. A starter of this type was shown at the Centenary exhibition. Other noteworthy Stone products include the crankcases for the Napier Deltic marine engine, now in full-scale production.

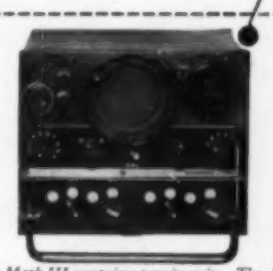
T.I. ALUMINIUM, LTD., is the sales and administrative organization for the Aluminium Division of the Tube Investments group of companies.

The advent of Tube Investments, Ltd., into the aluminium industry took place in 1932 when a member-company, Reynolds Tube Co., Ltd., began manufacture of aluminium tubes for the aircraft industry. Expansion into the extrusion side of the business was a logical step and from 1935 onwards the demands of the re-armament programme encouraged rapid growth in production. In 1940 a new factory was erected at Redditch for M.A.P. and the capacity for light-alloy tubing was raised to 4,000,000ft per month. Concurrently the demand for high-strength extruded sections became such that a second factory was erected on the same site in 1942. At this time nine extrusion presses, including one of 5,000 tons capacity, were in continuous operation.

At the end of the war these factories were acquired by Tube



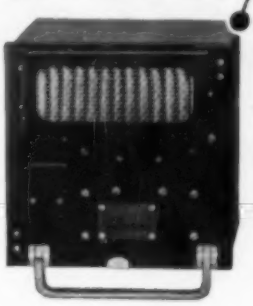
GEE Mk 111 Airborne Navigational Equipment by COSSOR



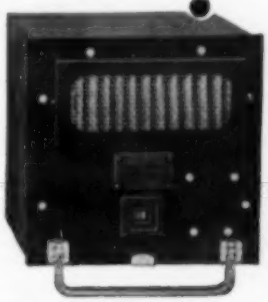
1. Gee Mark III comprises 3 main units. The small indicator is the only unit which has to be accessible to the pilot during flight.

Gee Mark 111 is the latest airborne equipment produced by A. C. Cossor Limited for use in the Gee System of hyperbolic navigation. Used extensively by the R.A.F. and Continental Air Forces, it has also proved its worth in the Viscount fleet operated by Aer Lingus. Inexpensive, it is absolutely reliable in operation with position accuracy limits between ± 100 yards at points close to the chain, and ± 0.5% of the range at distances greater than 100 miles from the centre of the chain.

Gee Mark 111 is a navigational aid with immense possibilities for civil airline operators and private owners.



2. The Waveform Generator, which incorporates Strobe Timer circuits, Strobe Generator and Square Wave Generator, and Divider Stages.



3. The Receiver which, with the Waveform Generator, can be installed anywhere in the aircraft up to 25 feet from the Indicator Unit.

GEE Mark 111 features include....

miniaturisation

remote controls

calibrated Strobe controls

TECHNICAL SUMMARY

	DIMENSIONS Height	Width	Length	Weight lb. oz.
Indicator Type 726 :	6½ in.	9 in.	10 in.	16 8
Waveform Generator Type 772 :	8 ,,	8 ,,	12½ ,,	21 0
Receiver Type 73673 :	8 ,,	8 ,,	12½ ,,	21 8
Indicator Junction Box Type 7359A :	3 ,,	6 ,,	2 ,,	1 4
Waveform Generator Junction Box Type 7360A :	5 ,,	8 ,,	2 ,,	1 7
Receiver Junction Box Type 7361A	5 ,,	8 ,,	2 ,,	1 10

OVERALL WEIGHT Approximately 67 lb. (including junction boxes).

FREQUENCY RANGE 22-85 Mc/s in 10 preset channels.

ACCELERATION GRADE Grade 1 as defined in B.S. G100.

CLIMATIC GRADE Grade 1 as defined in B.S. G100.

BANDWIDTH The receiver bandwidth is approximately plus or minus 750 kc s at 6 db down. The second channel, and all spurious responses, is at least 40 db down.

POWER SUPPLIES A.C.: 220 watts at 80 or 115v, 400 to 2,400 c.p.s. If required, a suitable Rotary converter is available to provide 115v 1,600 c.p.s. from 24v D.C. supply.

AMBIENT TEMPERATURE RANGE – 40°C to + 55°C.

AIR REGISTRATION BOARD APPROVAL

COSSOR

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COSSOR HOUSE · HIGHBURY GROVE
LONDON · N.5

Telephone: CANonbury 1234 (33 lines)
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Cooling was his headache

Dimetrodon, however fearsome he may have appeared around his Palaeozoic stamping ground, had a basic design problem that he never fully overcame. He warmed up in proportion to the cube of his all-up weight and he cooled off as the square of his skin area. Even the addition of a cooling fin couldn't prevent him from overheating in moments of stress. This defect may have contributed to his ultimate extinction.

When excessive temperatures present special problems to the aircraft designer, in particular, problems associated with fuels and lubricants, he has no need to wrestle with them alone. He can always obtain expert advice from Esso on the most suitable fuels, oils or greases to stand up to any given conditions. Esso experts are equally ready to advise him on problems connected with prospective designs.

It pays to consult

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THE BRITISH LIGHT-ALLOY INDUSTRY . . .

Investments, Ltd., and operated under the title "Reynolds Light Alloys, Ltd." Six extrusion presses, from 1,000 to 5,000 tons, were retained in commission, and these allow production of extruded sections of any size up to the maximum, which is a cross-section falling within a 16in diameter circle. On the tube side facilities allow manufacture of tube from ½in to 10½in diameter with wall thicknesses varying from 0.006in to 1in as regular production items, but tubes of 12⅝in diameter with a half-inch wall thickness have been made to special order.

At the present time the Redditch Works of T.I. Aluminium, Ltd., with a working area of some 250,000 sq ft, is one of the largest and most modern plants in Europe engaged solely in the production of aluminium and aluminium alloy tubes and extruded sections.

In the mid-thirties the increasing call for light alloy sheet and strip led Tube Investments, Ltd., to lay down a sheet and strip mill, operated under the name of "Reynolds Rolling Mills, Ltd.," at Oldbury. The chief product of the mill in the immediate pre-war years and during hostilities was high-strength sheet and strip for the aircraft industry.

After the war, to meet the expected demand from the civilian markets for pure aluminium and for the lower-strength non-heat-treated alloys, it was decided to adopt semi-continuous rolling on mass production lines. To implement this radical change in production technique demanded a completely new plant and in 1946 Tube Investments, Ltd., acquired the works of the South Wales Aluminium Co., Ltd., at Resolven, Glamorganshire. Existing buildings that could usefully be converted into the new scheme covered some 200,000 sq ft, and to house the new mill construction of new buildings covering a further 272,000 sq ft was started.

This new plant, which has only recently come into full production, is the latest and most modern of its type in Europe. Though of remarkable technical interest it is outside the scope of this review for, as implied above, it does not produce specification material for the aircraft industry. The heat-treated alloys forming the bulk of aircraft requirements are catered for in an annexe to the main rolling mill. This is a new building housing hand-fed "two-high" sheet and strip mills. Initial breakdown of the rolling slabs takes place in the main plant and final cold rolling to size is done on the hand mills, which are adjacent to a new and modern heat-treatment department, a feature of which is hot-air-conveyor drying for sheets after quenching. The entire hand-mill annexe is so constructed that there are no places for dust to lodge and so impair surface finish of the sheet rolled.

Throughout the plant, state T.I. Aluminium, each piece of equipment has been selected as the best of its type to contribute to the production of sheet of consistent quality. Especially is this so in the foundry, where the holding furnaces each contain as much as ten tons of metal. From these the melt is run into water-cooled dies which have platens that are slowly lowered under infinitely variable hydraulic control as casting proceeds. As the metal solidifies in the cooled die the slab so formed descends to increase in length until the desired weight is attained. The largest rolling slabs, 50in x 10in in section, are cast in pairs, the total weight of metal involved being six tons.

In aircraft material particularly, the importance of close adherence to specification limits is obvious. To ensure that every rolling slab or extrusion billet passing into production is of correct analysis, T.I. Aluminium analyse the metal while it is still molten, using an electronic apparatus known as a Quantometer. Within two or three minutes of taking a test sample, this equipment will determine the precise percentages of up to thirteen elements that may be present in an alloy. The result is signalled to the furnaces, so that if any adjustment in composition is needed it can be made and verified before the actual casting operation begins.

ALUMINIUM ON SHOW

Some Points of Aeronautical Interest at the Festival Hall Exhibition

THE "Aluminium 1955 Exhibition," held at the Royal Festival Hall, London—and concluding today, June 10th—forms a stimulating review of the uses of aluminium in industry. Almost every field in which the metal is at all commonly used is covered by actual examples, models or photographs; and many of the structural engineering exhibits and vehicles, shown out of doors, are of extremely large dimensions. Organized by the Aluminium Development Association on behalf of the industry, to celebrate the centenary of the making of aluminium in Britain, the exhibition was designed by Mr. Ronald Dickens, M.B.E., F.S.I.A.

On Friday last, June 3rd, the Duke of Edinburgh visited the exhibition.

Most of the exhibits in the aircraft section are shown indoors. Although the descriptions given are very informative, many of the components are to some degree anonymous, since, though the aircraft or engine manufacturers for whom many of them were made are named, indication is seldom given of the identity of the particular casting or forging specialists concerned.

An interesting historical example is a Hawker Heron light-alloy (HE14) airscrew blade of 1925, and by contrast there is a Rotol blade for a Sea Fury, forged from D.T.D. 150 wrought alloy. A complete Alvis Leonides helicopter powerplant illustrates the employment of such alloys as LM14(Y) for cylinder heads and complex components cast in LM7 and L40.

A great many of the exhibits illustrate the modern tendency in aircraft production to machine components from massive forgings or extrusions. An example is a de Havilland main spar boom machined from the largest extrusions yet made, weighing 1,070 lb: the finished job scales 324 lb.

There is a representative group of heat exchangers, oil coolers, intercoolers and similar equipment by Marston Excelsior, in L61 alloy and brazing sheet, dip-brazed. An oil cooler by Delanay Gallay, Ltd., illustrates a 50 per cent weight saving on traditional materials.

Reynolds Tube Co., Ltd., display pressure containers, manipulated from light-alloy tubing, for various purposes, as do Dunlop. Among the larger assemblies is a Canberra front fuselage frame, by G. Johnson and Brothers, Ltd., in a 3-in diameter 12 s.w.g. tubing in NT4 alloy.

Other exhibits include a Bristol reduction gear casing in L51; a Fairey rib in D.T.D.687; a Rotax turbo-starter, illustrating the chief reasons for adopting aluminium alloys; de Havilland (Ambassador) undercarriage components in D.T.D. 683; British Messier undercarriage components for the Britannia, in a similar material; sandwich panel constructions by A. V. Roe and Essex Aero; a Plessey pump body; blading by Rolls-Royce; and a Comet alternator cooling-air intake with the Napier de-icing system, which utilizes a sprayed-aluminium metal element.

Out of doors, S.M.D. Engineers, Ltd., are showing a 50ft by 25ft hangar door, and Aero Controls, Ltd., as mentioned on an earlier page, a 30ft aircraft servicing tower.

TITANIUM POWDER-METALLURGY

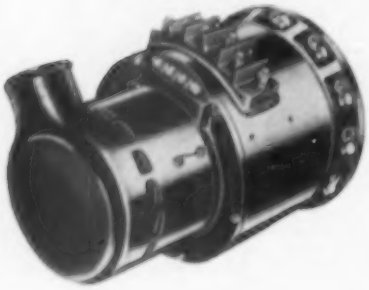
POWDER metallurgy is among the many fields of inquiry which occupy the attention of the research laboratories of the General Electric Co., Ltd., and one of the newer materials studied in this connection is titanium. The laboratories have recently published some notes on their work in this direction.

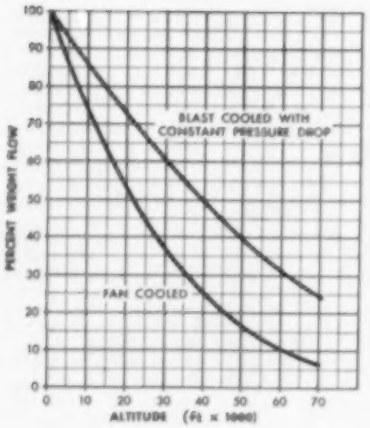
Among the difficulties associated with the powder metallurgy of titanium is that of obtaining finely divided powder uncontaminated by oxygen or nitrogen. Pure titanium sponge, obtained by reduction of the tetrachloride by magnesium, is too malleable to be crushed into powder, by virtue of its very freedom from these embrittling elements. Titanium powder produced by the reduction process is found to give rise to hard brittle compacts after sintering *in vacuo*, owing to the presence of oxygen and nitrogen in the powder.

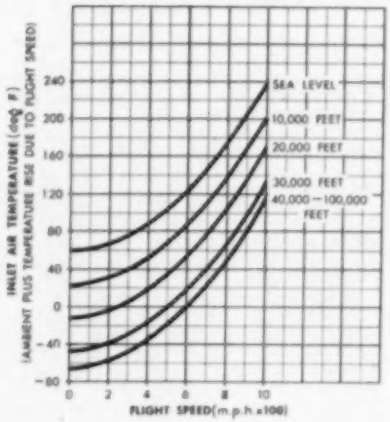
A method developed at the G.E.C. laboratories has enabled small quantities of titanium or titanium hydride, substantially free from oxygen and nitrogen, to be produced in finely divided form. The process consists in embrittling pure titanium sponge with hydrogen under carefully controlled conditions. The titanium hydride can then be sintered as such, hydrogen being evolved during the sintering process. Alternatively, the hydrogen can be removed by a separate vacuum treatment at temperatures up to 800 deg C, to leave fine titanium powder.

After grinding, state G.E.C., the hydrogenated sponge can be satisfactorily pressed and vacuum sintered to give hardness values of less than 200 D.P.N., provided that the powder is screened and the very fine (— 300 mesh) fraction removed. Owing to its large surface area, this powder is naturally very reactive, and becomes superficially contaminated during grinding. The remaining hydride powder is quite stable over long periods and can be used as a base material for the preparation of massive titanium or titanium alloys by powder metallurgical methods.

The J. and H. G282 alternator (below) is an advanced air-cooled unit capable of accepting 120-deg C intake air. The curves show altitude influence upon blast-cooling airflow and (far right) flight-speed effect on inlet air temperature.







Oil-cooled Generators

ADVANCED ELECTRICAL MACHINERY FOR FAST, HIGH-FLYING AIRCRAFT

THIS article is based on a report prepared by Jack and Heintz, Inc., an American firm specializing in aircraft electrical machinery. The principal authors of the report are O. E. Buxton, project engineer on oil-cooled A.C. generators, and Charles R. Dunfee, district manager, N.Y. office. The company state that they would welcome specific requests for further information from other engineers working in this field.

FOR many years, air has been the accepted medium for cooling aircraft generators and other rotating electric accessories. Such an arrangement is essentially simple, air being rammed into a duct leading to the accessory and then dumped overboard slightly hotter than it was before.

Many present aircraft will continue to employ air cooling and development is attempting to extend the limitations of such equipment. Modern air-cooled generators are being redesigned with high temperature components, new insulations, "free flow" air passages and other innovations. The American firm of Jack and Heintz, Inc., of Cleveland, Ohio, recently announced an air-cooled generator—it is illustrated on this page—capable of operating with inlet-air temperatures as high as 120 deg C (248 deg F). Nevertheless, this company—and others—have appreciated that air-cooling can no longer be relied upon either in supersonic flight or at sustained altitudes greater than 40,000ft. In the first case ram temperature rise is excessive and in the second the weight of air that can be handled by normal ducting is considerably reduced. These factors do not of themselves preclude the use of air; the governing factor is the necessity for making fundamental design changes to increase the cooling effectiveness.

Studies have indicated that the practical limits of air-cooled machines are determined by inlet-air temperature, the maximum permissible values being about 120 deg C at sea-level, 40 deg C at 50,000ft and minus 12 deg C at 65,000ft. Air cooling might be taken beyond these limits, but Jack and Heintz feel that the effort expended would not be worth while in view of the new liquid-cooled machines now available.

It was in 1949 that the American firm initiated development of the liquid-cooled G37, a 30V, 300-amp D.C. generator weighing 66 lb. This generator was available before aircraft had encountered flight conditions requiring it, but it served to alert the industry to the feasibility and exceptional potential of oil-cooled units. During the past six years, therefore, Jack and Heintz engineers have steadily explored the various factors associated with oil-cooling, such as installation, sealing, bearings and coolants. The company is now in pilot production of several oil-cooled units and Standards for such equipment are being evolved.

G129 oil-cooled D.C. generator.

Four such units are illustrated. The internal cooling system of one of the new machines is also shown schematically. Oil enters at the mounting pad, where it returns to the engine after being circulated through the stator and rotor. A major difference, compared with a blast-cooled machine, is that the main rotor mounting need have only one bearing (at the anti-drive end), the bearing at the other end being supplied by the drive. The liquid used would typically be lubricating or hydraulic oil tapped from, and returned to, an existing circuit.

Oil-cooled machines are smaller in diameter, and possibly shorter, than comparable air-cooled machines, since air ducting is replaced by tubing. For example, oil pipes of half-inch overall diameter can replace three-to-four-inch ducting and still larger shrouds. Fundamentally, the cause of the slimmer configuration is thermal. Temperature gradients exist in air-cooled machines both axially and radially and air generally loses its effectiveness as a coolant before it penetrates fully into a generator. Therefore, provision has to be made for a considerable air blast against the face of the generator and this accounts for recent increases in diameter. In oil-cooled machines, axial temperature gradients are substantially lower and cooling can be effected by employing axial oil ducting.

The latest air-cooled machines require a fan and water-separator, which again increase the overall bulk of such equipment. It appears that the minimum diameter of an oil-cooled generator is determined by the diameter/length ratio compatible with good electrical design. The reduction in bulk and the elimination of ducting has already been found substantially to alleviate congestion around turbojets, even when allowing for slight increase in the capacity of the oil heat-exchanger.

Air cooling has always involved some drag. This is eliminated or considerably reduced with oil-cooled accessories, and under certain conditions—such as high speed at low altitude—the fuel consumption is sufficient for fuel/oil heat exchangers to perform all the cooling of both the engine and the accessories. At high altitudes, air/oil heat exchangers may also be required, but the air requirements will be low owing to the high cooling efficiencies possible. It has been found possible, in fact, to employ a recirculating system which can be switched from one heat-sink to another according to the environment or operating condition. In some cases, bleed-air ducts from the engine can be eliminated, so improving the engine performance.

The altitude limitations of air-cooling necessitate the derating of generators at high altitudes. Liquid-cooled machines, on the other hand, have a performance independent of flight speeds and ambient conditions so long as proper oil inlet temperatures and flow rates are maintained. For example, the J. and H. G190 will deliver 40 kVA at 0.75 power factor as long as five gal per min of oil is available at a maximum of 300 deg F. In the design of air-cooled generators, the operating level is increased until some part of the machine reaches its critical limit. Successive improvements then shift the design problem from one component to another until, in theory, the perfect machine is reached in which each component reaches its critical limit at the same temperature. Nevertheless, even with careful design, it is practically impossible to eliminate high spots in blast-cooled machines.

In liquid-cooled machines, gradients are mainly radial and depend principally on the load (since the coolant flow is independent of altitude). Furthermore, the temperature rise of the oil is low enough to ensure that all components receive cooling liquid at roughly the same temperature. It is thus possible

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This Dual Aircraft Starting Set gives either 28 or 112 volts at the touch of a switch

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COMET 3

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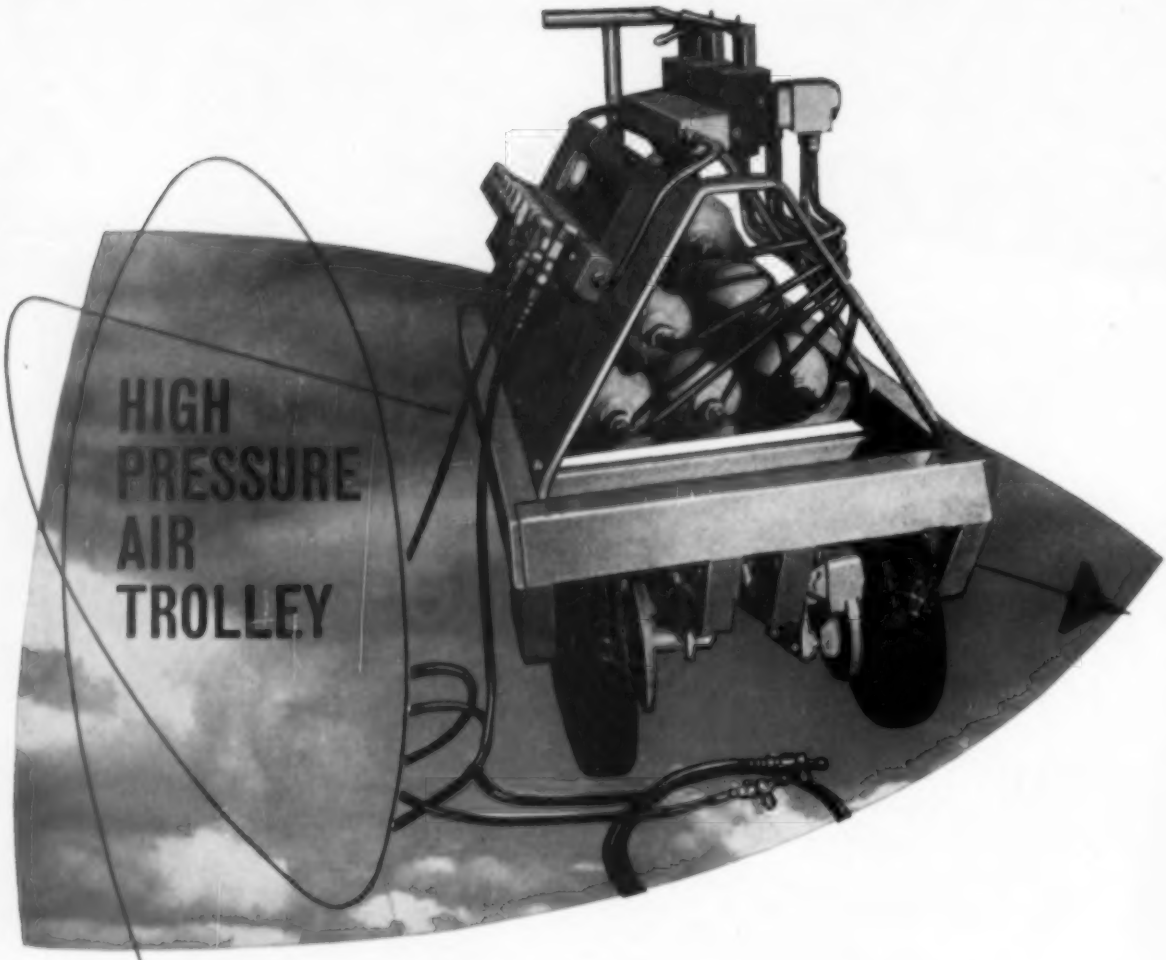
FOREMOST IN HIGH-PRECISION HYDRAULICS



The trolley incorporates six air cylinders which when charged to a pressure of 3,300 lb./sq. in. gauge contains 36 lb. weight of air.
Provision is made for charging or discharging the bottles in pairs, enabling any pair to be used separately or in combination.
A charging point is provided.
All the equipment is mounted on a steel chassis, fitted with pneumatic tyred wheels, parking brake and telescopic draw bar.
A metal canopy, with a sliding side panel giving access to the control valves, enables the trolley to be used out of doors under most weather conditions.

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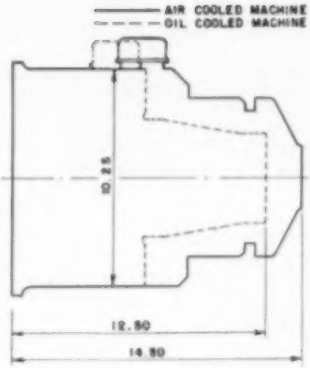
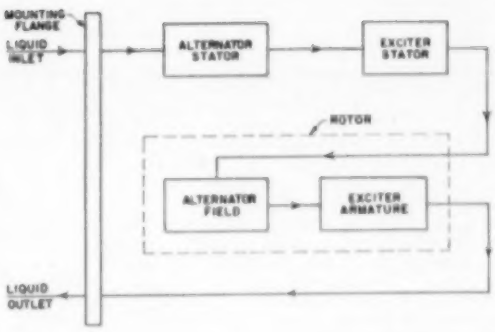




The size reduction obtained by using oil cooling is typified by the diagram; at far right is a schematic diagram of the oil-flow.

OIL-COOLED GENERATORS . . .

greatly to reduce hot spots and thermal gradients which, in turn, minimizes numerous problems which previously reduced generator life and reliability.

One of the most serious component problems used to be the failure of bearings. The trend towards the use of only one bearing in liquid-cooled machines greatly simplifies the control of bearing operating conditions. Another advantage is that grease-lubricated bearings can be replaced by more efficient oil lubrication, a modification which is simplified because oil is already circulating through the machine.

It is a significant fact that Jack and Heintz foresee the possibility of establishing a standard generator for each required rating, the service limits of these machines then being governed by modification to the heat exchanger with which it is associated. Thus, an oil-cooled generator can serve as wide a range of environments as the efficiency of the heat exchanger and bulk flow of oil will permit. Generator design, therefore, becomes important only in the light of electrical requirements.

Summing up in the light of present knowledge, the following conclusions can be drawn. For flight at low altitudes and low airspeeds there is no objection to the use of blast-cooled electric machinery.

For high altitudes and short periods at high speeds blast-cooling is still practicable, provided flight and load cycles are checked against evaluation charts to pick the proper machine. Liquid-cooled machines should certainly be considered whenever inlet-air temperature may exceed 120 deg C at sea-level. For a wide range of supersonic speeds at high altitudes, oil-cooled machines are essential. Here the capacity of the heat-sink must be determined to establish the liquid temperature level that can be maintained. Together with knowledge of the liquid employed, this will determine the operating limits of the machine.

At the extremely high flight speeds and altitudes now being encountered by missiles, thermal lag or vapour-cooled machines may be required. At present, the former type of machine is suitable only for applications involving short duration. By far the greatest promise for extreme service and long operating periods are the J. and H. vapour-cooled units already being extensively used in various missiles. There are two such machines in pilot production—the G75 (illustrated) and the G188, operating at 12,000 r.p.m. and rated at 12 and 30 kVA respectively.

A vapour-cooled machine operates in the following manner. Coolant, usually water, is injected under pressure into the hollow shaft of the generator. The water is flung centrifugally from four ports and scatters as a fine spray over the interior of the machine. As it picks up heat, the water vapourises and escapes through an exhaust port as steam. These vapour-cooled machines are as near environment-free as any yet developed. They appear to be practical for aircraft as soon as the question of coolant requirements is resolved. The G188 machine uses approximately 9 lb of water per hour at full load.

G52 oil-cooled 9.5 kW generator.

G280 oil-cooled 15 kVA alternator.

G51-1 oil-cooled 2.5 kW generator.

G75 vapour-cooled alternator for missiles, delivering 12 kVA at 120 V (0.8 power factor, 3-phase, 400 c.p.s.) at 12,000 r.p.m.

ENGINEERING DATA ON NEW J & H OIL-COOLED GENERATORS

	G51-2	G52	G129	G190	G192	G280
Nominal rating ...	2,500 W	9,500 W	100 amp	40 kVA	20 kVA	15 kVA
Volts	S	S	28	120/208	120/208	120/208
Speed (r.p.m.) ...	12,000	12,000	8,000	6,000	8,000	12,000
Phase...	S	S	D.C.	3	3	3
Frequency (c.p.s.) ...	S	S	S	400	400	400
Power factor ...	S	S	S	0.75	0.75	0.75
Weight (pounds) ...	30	70	35	165*	100*	50
Moment (lb-in) ...	165	400	145	2,250*	1,100*	225
Length (inches) ...	13.0	15.0	10.84	27.25*	26.0*	13.25
Diameter (inches) ...	4.5	7.75	6.5	13.0*	9.0*	7.19

* Includes constant-speed drive. S=Special characteristics to meet customer requirements.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

Supersonic Fuselage Design

YOUR contributor "W.T.G.," in his article on the Super Sabre in your issue of May 20th, states that the avoidance of high peak suction points is a primary factor in the reduction of supersonic drag.

It is true that high peak suctions, and therefore velocity, will cause an increase in drag in the transonic region, since they will cause local supersonic conditions. But where the airflow is everywhere supersonic, pressure distribution depends on the angle through which the airflow is turned. A surface turned at an angle against the airflow will cause a shock-wave and an increase in pressure; a surface turned away from the airflow will cause an expansion. Under these conditions the peak suction points will not coincide with the points of maximum thickness as in subsonic flow.

Thus it seems that the main thing to avoid at supersonic speeds is a large increase in cross-sectional area over a small chordwise distance, since this will cause high pressure over the forward part of the body. If the fuselage of the Super Sabre were of the "Coke-bottle" type, and if it had to contain the same quantity of fuel as the present fuselage, then the fuselage cross-sectional area would have to be greater in the regions of the leading edge and trailing edge of the wing. This fattening of the forward fuselage would cause higher pressures over the fuselage nose, since the surfaces would be inclined at a greater angle against the airflow.

Your contributor suggests that the Grumman Tiger and Convair F-102 were designed in the light of later knowledge than the Super Sabre. However, the "Coke-bottle" fuselage was known about as long ago as 1949, and probably earlier, and so I suggest that the differences in design represent different approaches to the same problem.

B. R. A. BURNS, F/O.

Church Fenton, Yorks.

"Monticule" Airfields

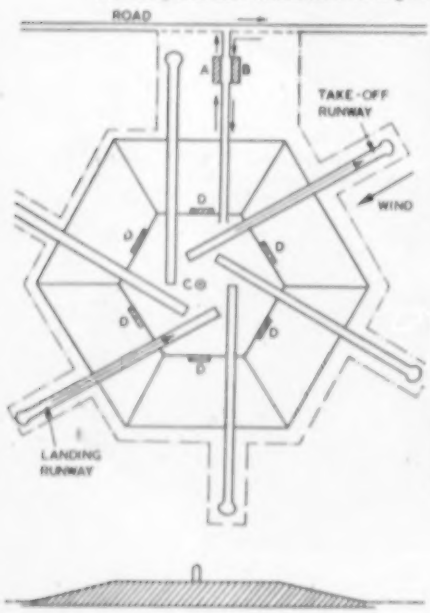
IN order to increase take-off and landing safety and enable aircraft to operate on shorter runways, I suggest the adoption of an airfield design incorporating inclined runways. They would be inclined by construction of the central area of the airfield as an elevation or monticule, so that they would run on the flat top, down its sloping sides, and on to the boundary.

An aircraft taking off would gain acceleration as it ran down the inclined middle section and would attain flying speed after a shorter run. It would take off as soon as it reached the beginning of the final level stretch, the remaining length of which, as far as the boundary, would be available in case the take-off run was abandoned in emergency.

In a landing, the aircraft would land on the level base stretch of the offset landing runway; braking would be unnecessary, as the up-gradient would absorb the forward momentum. The offset runway would prevent the possibility of collision and the inclined section would be a safeguard against all chances of over-running.

Boosters might thus be eliminated and tyre wear and fatigue reduced, and this would lead to improved design.

Inclined runways would require less land and would increase visibility. Fuel would be saved, as the acceleration the aircraft received as it ran down the gradient would represent the momentum of the previous landing, utilized to take the aircraft to the top instead of being dissipated in the brakes and in cutting up the tyres.



Mr. H. Ellul's "monticule" airfield shown diagrammatically in plan and cross-section (dictionary definition of a monticule is "a little mount, a hillock, a small elevation"). A and B, inbound and outbound passenger-handling buildings; C, control tower; D, technical buildings.

The circumstances which might cause an aircraft to go round again rather than over-run the boundary could not arise when the landing momentum was cancelled during the run up the slope, particularly as a further length of runway would be available at the top; and in a take-off, as flying speed would be assured by the run down the slope, the necessity to abandon a run should not arise; if it became necessary for some other emergency, the full length of the final, base section stretch of the runway would be available.

HENRY ELLUL.

London, W.3.

Lawrence and "The Mint"

SINCE the publication of *The Mint* and its review in your pages [March 18th] I have been expecting informed comment from your readers.

In lifting the lid from conditions at the Uxbridge Recruits' Depot of the early twenties, it may appear that T. E. Lawrence colourfully exposes a poor relation of Belsen or Buchenwald. And your reviewer gives me the impression that he considers bad N.C.O.s were mainly responsible. I would disagree with him. No N.C.O. is better than the commanding officer leading or failing to lead him. The pace or standard of subordinates is determined by the pace of their superiors. Only in the Duke of Plazo Toro's Air Force do corporals lead group captains.

The general responsibility for the savage discipline in "T" Section must rest on the staff officers with their "Brigade of Guards" outlook. And the local responsibility rested solely with the camp commandant. He was a high-ranking officer well known to the Staff, and he was posted to the depot for a purpose. He wasn't the camp bossman by accident. It is a mistake, I think, to couple with him (as does your reviewer) the drill adjutant. The latter was a much junior officer and drill was his bailiwick. He was devoted to it. As well blame a doctor for devotion to medicine. But the camp commandant confused discomfort with discipline. Lawrence has dealt with him.

Circumstances placed me (a technical N.C.O. at the time) on the Recruits' Depot a few months before Lawrence entered. It was hot. N.C.O.s were treated more harshly than were airmen. I was there for two months and afterwards associated with Uxbridge for a year. The drill adjutant ("Stiffy") was a martinet but he was not mean; rough-tongued but not unfair.

The "Brigade of Guards" outlook was not new to the R.A.F./R.F.C. in 1922 either. It was in full evidence in the Guards-dominated Recruits Depot at Farnborough in the fall of 1915 (I was there also).

The essential difference between the Farnborough Mint and the Uxbridge Mint was that in the latter a famous author passed through and has now "blown the gaff." *Per Ardua ad Lawrencia!*

EDWARD HOCTOR (ex-10716 R.F.C.).

Dublin.

Jet Lift

YOUR contributor "Quidnunc" [May 13th] has overlooked his best bet. If the lift engines can be deflected in flight, so can the main engines. If he will tilt them upwards until they produce a vertical lift component of 100,000 lb he can dispense with a further ten lift engines; the main engines will still produce a horizontal thrust component sufficient to give an initial acceleration 0.2g. The maximum acceleration and retardation during take-off and landing will be slightly less than before (for which his passengers will be grateful!) but the consumption of pure *lift* fuel will not be increased. In this way he could produce a "Mark IV" model with the same performance as his Mk III but a payload 10,000 lb greater.

The last logical development would seem to be the provision of the necessary lift engines, fuel *and undercarriage* in a separate aircraft, to be detached from the airliner as soon as sufficient speed is reached, and to pick it up again before landing. It still remains to be proved, however, that travel at supersonic speeds is worth while. Over short distances the time wasted getting to and from the termini (under present-day conditions) destroys its value; while for long journeys the optimum travelling time is about 8-10 hours, irrespective of distance, since this allows the passenger to travel overnight in the time which is normally devoted to no useful purpose. If he can go to bed in London and wake up in New York he has effectively travelled to his destination in no time at all. But if he is really in a hurry, he would be far wiser to stay at home and use the transatlantic telephone.

It may be urged that goods cannot be sent by telephone. That is true; but the following facts provide an interesting commentary on this. I am in urgent need of a 36-volt metal rectifier for my charging-board. I can find no retailer who can supply from stock; and the most honest of those I have consulted warns me

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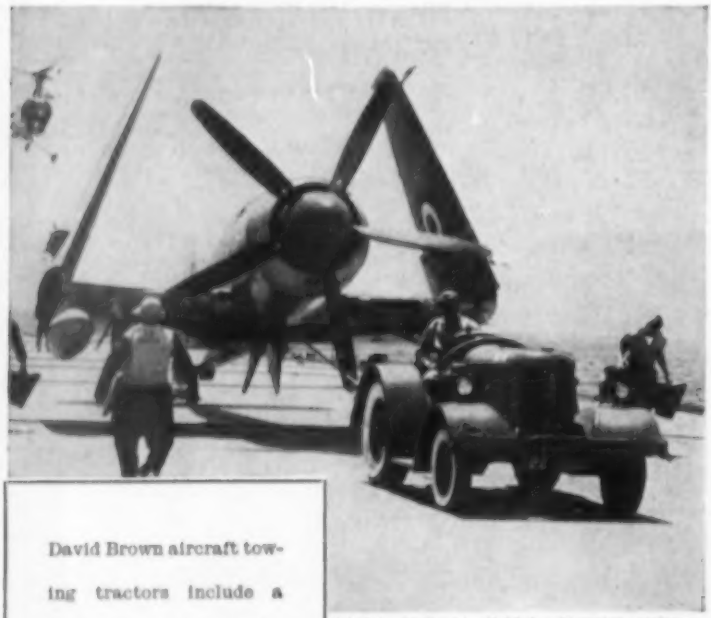

Flight deck of H.M.S. Warrior taken during exercises in the Japanese Inland Sea

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CORRESPONDENCE . . .

that he has never known the firm who make such things to supply anything in less than six weeks from the date of ordering. So far as I am concerned, therefore, rapid transit is of no importance whatever; while the firm concerned will require considerable internal reorganization before it pays them to despatch their goods by air, at any cruising speed.

Horning, Norfolk. N. YOUNG.

CORRESPONDENCE IN BRIEF

Referring to a Royal Aero Club list of Committee members published in our issue of May 6th, the Association of British Aero Clubs and Centres comments on the appearance, under the heading "Other Representatives," of an R.Ae.C. Committee member's name against the name of the A.B.A.C. The Association state that co-opted members of their Council retire at the same time as elected members; these retired last December, and the R.Ae.C. "have not again been invited to nominate a representative of their Committee for co-option to our Council."

FORTHCOMING EVENTS

May 30-June 10.	Canadian International Trade Fair and Air Show, Toronto.
June 1-10.	Aluminium 1955 Exhibition: Royal Festival Hall, London.
June 1-11.	British Plastics Exhibition and Convention: Olympia, London.
June 1-18.	Royal Tournament, Earls Court, London.
June 3-17.	Aeronautical Union of Jugoslavia: Sixth Federal Gliding Contest, Jugoslavia.
June 7-15.	French Aero Club: F.A.I. 50th Anniversary Rally, Paris.
June 10-19.	Paris Aero Show.
June 11.	R.Ae.C.: Third National Air Races meeting, Bristol.
June 11.	Royal Air Forces Association: Air Display, R.N.A.S. Sydenham, Belfast.
June 11.	Aircraft Golfing Society: Match v. Racing Club de Paris, La Boulie, Paris.
June 17-24.	F.A.I.: General Conference.
June 18.	R.N.A.S. Eglinton, Northern Ireland: Air Day.
June 18.	R.N. Electrical School, H.M.S. "Ariel," Worthy Down, Winchester: Air Day.
June 20-July 1.	I.A.S. and R.Ae.S.: Fifth Anglo-American Aeronautical Conference, Los Angeles.
Sept. 5-11.	S.B.A.C. Show, Farnborough.

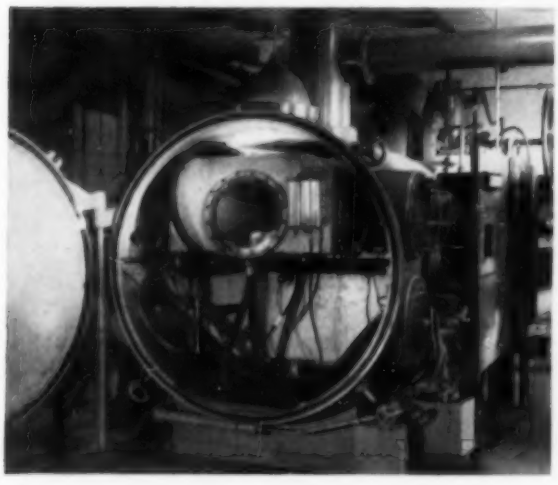
AIR-DRIVEN FUEL BOOSTER PUMP

DIFFERENCES in design between one type of fuel booster pump and another have generally concerned details rather than fundamentals. Most such units have, in the past, employed centrifugal impellers driven by adjacent electric motors, the complete unit then being mounted in the bottom of one of the fuel tanks of the aircraft. In common with other airborne accessories, fuel booster pumps are having to meet ever-increasing demands. In particular, the flow rates required by modern military powerplants are enormously greater than anything visualized even ten years ago, and the sheer power required to drive booster pumps capable of delivering over 3,000 gal/hr poses considerable problems. Even discounting the accentuation of difficulties resulting from the trend towards high-speed wings of thin section, it is becoming very hard to accommodate electrically driven booster pumps of the size and weight which are now required.

A specialist firm in this field is the Self-Priming Pump and Engineering Co., Ltd., of Slough, Bucks, who have long been one of the world's principal suppliers of tank-mounted booster pumps. They saw that the advantages of driving a high-rated booster pump by an air turbine running on compressor-bleed air merited careful consideration, and that such a unit would be extremely attractive from the aircraft design standpoint. The company have now developed such a unit, with a current rating of 3,500 gal/hr at 11 lb/sq in. It embodies a two-stage centrifugal pump driven through bevel gearing by a two-stage impulse turbine which is supplied by air tapped from the main compressor of the engine. The air is normally bled off from the first or second compressor stage but air at a higher pressure—and consequently hotter—can be employed. The bleed air is ducted through a governing valve to the turbine rotor and then to the exhaust connection *via* a heat-insulating jacket which surrounds the inlet elbow.

After passing through the mesh filter, the fuel is picked up by a helical impeller which performs the dual functions of de-aerating and pressurizing the fuel before the latter is fed to the main impeller. It is clearly desirable that the consumption of air should be kept to a minimum, and the pump incorporates a governing unit which is acted upon by a pressure-sensing device to maintain a constant delivery pressure of approximately 11 lb/sq in. This governing unit restricts the supply of air to the turbine and closes automatically when the pump load is reduced, so preventing over-speeding. Lubrication of the gearing, turbine rotor and upper pump-shaft bearings is accomplished by mounting these units in an oil bath. A carbon bearing is fitted at the lower end of the main spindle and this bearing is lubricated by the fuel. The whole assembly is mounted on a sump plate, which is then attached to the tank floor in the usual manner, with the major part of the unit immersed in fuel.

In this photograph of the new S.P.E. development the turbine is on the left, together with its governor unit.



Equipment of this nature has to undergo the most thorough testing, and S.P.E. have now acquired a considerable background of experience in using their own altitude test chambers, in which high rates of climb up to a simulated altitude of 60,000ft can be accurately reproduced. The air-driven booster pump has already been subjected to very thorough testing through all its stages of development, and it has now successfully completed its type performance tests and is fully approved by the M.o.S.

At the present time, the improvement of the performance of accessories is a pre-requisite to better aircraft, and S.P.E. appear to have removed a significant restriction in power which previously applied to orthodox booster-pump design. It is generally agreed that the delivery quoted above is by no means the limit to which development may be restricted, and S.P.E. are considering the design of similar pumps with varying capacities, and one of these units may possibly replace the several pumps now employed on many aircraft.

At their Slough factory, the S.P.E. company employ this altitude test chamber in the development of fuel-system equipment for all types of high-performance aircraft.

THE INDUSTRY

Compact Power Generation

IN our recent notes on the exhibits in the engineering section of the British Industries Fair we referred to the Rover gas turbine, mentioning that in one of the applications demonstrated it formed the power unit of a Petbow generating set.

It is now possible to illustrate this equipment—which is designed as a highly portable source of mains power for a variety of engineering, Service and other uses—and to append some notes on the specification.

The lightness and compactness of the Rover gas turbine (60 h.p. continuous rating for about 120 lb weight) is matched by an alternator of unusually high output/weight ratio which was developed for the purpose by the Macfarlane Engineering Co., Ltd., of Glasgow in collaboration with Petbow. It is directly driven from a reduction shaft on the engine at 3,000 r.p.m. to generate a 50-cycle A.C. supply. Alternative versions are available for 60-cycle A.C. at 3,600 r.p.m. and for D.C. at 4,500 r.p.m. Maximum output in temperate climates is 40 kW (50 kVA A.C. at 0.8 power factor).

The alternator is self-regulating within ± 2 per cent of voltage at all rated loads and power factors without recourse to the usual separate automatic voltage regulator. Speed as well as voltage is closely controlled, and the engine governor is stated to maintain the output within 1 cycle (2 per cent) of the nominal 50 cycles between zero and full load.

The power unit is mounted inside a tubular steel framework which also supports the 20-gallon fuel tank and a control panel carrying voltmeter, frequency meter, main switch, fuses and overload warning lamps. All-up weight of the equipment is 1,200 lb; an equivalent mobile diesel-driven set of orthodox construction, state the makers, weighs some 6,000 lb.

Petbow, Ltd.—whose name will be familiar in the aircraft industry as makers of, *inter alia*, aircraft ground starting units—have their offices and works at Sandwich, Kent.

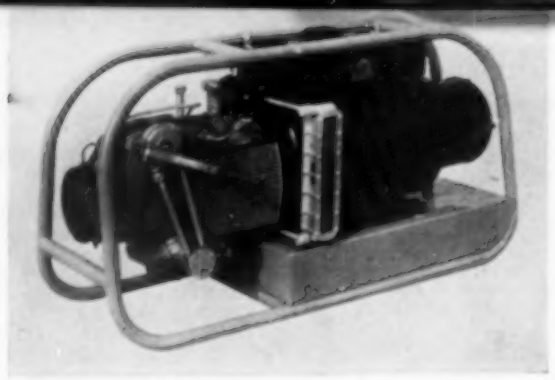
Bryans Aeroquipment Board Appointments

THREE executives of Bryans Aeroquipment, Ltd., have been appointed to the Board. They are Messrs. Jack Austin, as design director, Victor Lawton, sales director, and H. D. Strawson, O.B.E., production director. All three previously held the posts of "special directors" of their respective departments.

Mr. Austin has been with the company since its early days, controlling the design and drawing-office sides of the business. Except for a short break during the war, when he was with M.A.P., Mr. Lawton has served successively as sales manager, general manager, and sales director since he joined the company in 1939. Mr. Strawson took over the production side of the business when he joined in 1952, following employment with Imperial Airways and B.O.A.C., in the latter case as chief engineer (operations).

Other directors of the firm are: Mr. C. E. Stearns (chairman), Mr. J. R. Bryans (managing), Mr. M. C. Bryans, and Maj. P. W. S. Bulman, C.B.E., M.C., A.F.C., F.R.Ae.S.

Bryans Aeroquipment, Ltd., market test equipment covering the fields of gyroscopes, manometry, electrical temperature measurement (including jet-pipe thermocouples), oxygen breathing, cabin pressurization, sound recording, and artificial breathing and reaction testing for pilots. They have agents in over thirty countries throughout the world.



The Petbow generating set, powered by a Rover gas turbine (see col. 1).

Sintering Conference

BETWEEN June 20th and 23rd the second International Powder Metallurgy Conference will take place in Reutte, Tyrol, Austria. It is sponsored by Dr. Paul Schwartzkopf, president of the American Electro Metal Corporation of Yonkers, N.Y., and its theme will be "High Temperature and Corrosion Resistant Materials by Powder Metallurgy." Over 300 delegates from 17 nations have registered, including over 30 from the United Kingdom.

Reutte is the site of the largest powder-metallurgy works in Europe, that of the Metallwerk Plansee. The ferrous powder-metallurgy interests of Metallwerk Plansee are represented in this country by George Cohen Sinteel, Ltd., a subsidiary of The 600 Group of companies.

For a Smooth-running Industry

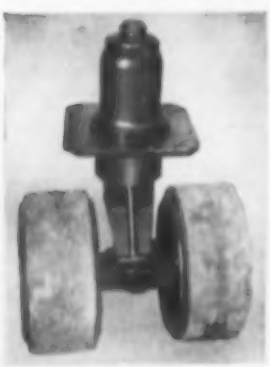
ON casual consideration such a product as a castor is apt to be dismissed with scant interest—"yes, of course, things that go on chair legs". Yet it is remarkable how many forms and how many sizes these simple fitments may assume, and how numerous their applications may be. Some idea of the scale of variety could be obtained by those visitors to the engineering section of last month's British Industries Fair who paused at the stand of Autoset (Production), Ltd.; this firm has designed and manufactured castors for many years, and supplies them to the majority of the leading airframe and engine manufacturers.

Diameters may range from an inch or so up to 4ft, and loads from 30 lb to five tons or more; castors may have steel, solid rubber or pneumatic tyres; plain, ball or roller bearing (bearings are among Autoset's other products); they may be of single, twin or triple type, and may incorporate locking devices, sprung mountings, anti-shimmy devices, and even internal-expanding brakes.

One of the best known uses for castors in the aircraft industry is, of course, for movable jigs, and Autoset have provided numerous types for this purpose, including some with vertical-movement jack mountings. Another frequent use is for engine stands, and the illustration on the right below shows a standard 7in castor which the company has supplied in thousands for this application.

The other photographs show (second from left) a typical pneumatic-tyred (16in × 4in) wheel of 11 cwt load capacity, designed for an airfield vehicle and provided with an anti-shimmy device; a three-wheeled one-ton-capacity transporter with a variety of applications in moving machines and structures; and (left) a twin-wheel (20in × 9in) oscillating-axle castor, of five tons capacity, designed for a transportable wind tunnel.

Autoset (Production), Ltd., whose works are at Stour Street, Birmingham 18, also make a variety of castor-mounted trolleys, steps, etc., and are in a position to design or make equipment of this kind to order.



Contrasting types and sizes of castor from the almost unlimited range made by Autoset Production, Ltd. Details of the four are given in the item immediately above.

"Ah, now I see, sir!"

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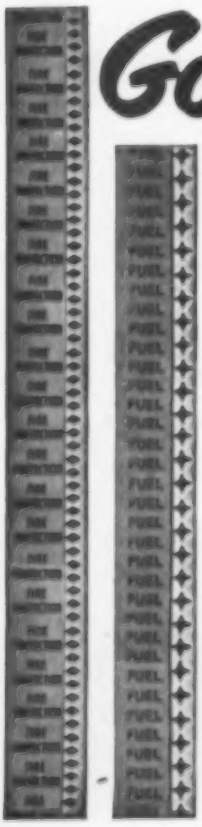

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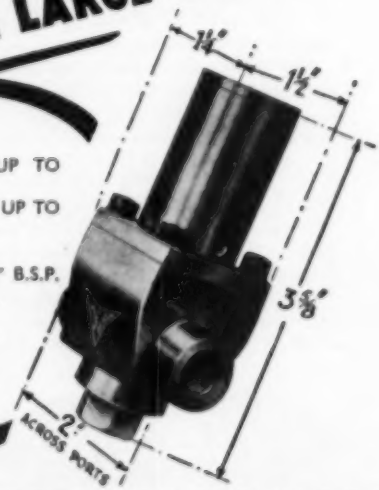

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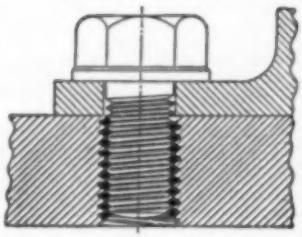

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THE AIR TRANSPORT ADVISORY COUNCIL give notice that they have received the undermentioned applications to operate scheduled air services:

APPLICATION No. 409/1. From Silver City Airways, Ltd., of 1, Great Cumberland Place, London, W.1, for an amendment to the terms of approval of the Vehicle Ferry Service which they are authorized to operate between Belfast (Newtownards) and Stranraer (Castle Kennedy) carrying not more than five incidental passengers on any one flight up to the 31st December, 1961, so as to permit them to carry up to 11 incidental passengers per flight for the period of the Glasgow, Edinburgh and Paisley fairs, normally from mid-July to mid-August each year, and on the occasions of International Rugby and Soccer matches held either in Belfast or Scotland.

FROM B.K.S. Air Transport, Ltd., of 1 Marylebone High Street, London, W.1.:—

APPLICATION No. 366/1 for an amendment to the Terms of Approval of the U.K. Internal Service which they are approved to operate between Leeds (Yeadon) and Belfast for the period up to April 30th, 1962, at a frequency of up to seven return flights weekly, so as to permit the Company to operate at a frequency of up to 21 return flights weekly.

APPLICATION No. 367/1 for an amendment to the Terms of Approval of the U.K. Internal Service which they are approved to operate between Leeds (Yeadon) and Southend for the period up to April 30th, 1962, at a frequency of up to seven return flights weekly, so as to permit the Company to operate at a frequency of up to 21 return flights weekly.

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on July 30th, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. [3837

GUIDED WEAPONS

PROJECT DESIGN

The Guided Weapons Department of The Bristol Aeroplane Company Limited at Filton invites applications from qualified Engineering Designers for appointment to the following posts:—

(a) DEPUTY PROJECT DESIGNER (AIRFRAMES)

Applicants should possess high academic or professional qualifications in aeronautical engineering and should have had considerable experience of the design of airframe structures, including recent experience of high speed aircraft or missiles.

(b) DEPUTY PROJECT DESIGNER (GROUND EQUIPMENT)

Applicants should possess good academic or professional qualifications in mechanical engineering, and should have had a great deal of design experience of fabricated structures and mechanisms, such as Medium ordnance equipment, road transport vehicles, or large-scale agricultural equipment.

Both appointments are of monthly staff status and carry a good starting salary, according to qualifications and experience.

They offer every prospect for advancement in a new and rapidly expanding field of engineering, and the guarantee of a permanent and pensionable employment, which only a large and well-established organization can give.

Applications, giving details of experience, qualifications, and age, quoting **D.O.40,** should be addressed to the **Personnel Manager, The Bristol Aeroplane Company Limited, Aircraft Division, Filton House, Bristol.**

DEVELOPMENT AND PRODUCTION

Manufacturers of materials handling equipment have vacancies for the following senior appointments:—

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(Also responsible for test)

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The Manager, London Design Office
SHORT BROTHERS and HARLAND LIMITED
208A, Regent Street, London, W.1,
quoting S.A.67.

GUIDED WEAPONS

The Bristol Aeroplane Company Limited at Filton offers the following appointments in the Guided Weapons Department:

(a) **FLIGHT DEVELOPMENT GROUP** Two Technical Engineers for planning a development programme. Both should have an Honours Degree in Engineering or equivalent professional qualifications. One should have experience of Automatic Control Systems and the other should have experience of Flight Development. In the latter case, specialized experience of structures and/or aerodynamics would be an asset.

(b) **A Project Planning Engineer** with sound general and mechanical engineering training and experience. An engineering degree or equivalent professional qualification would be desirable.

(c) **A Ground Equipment Engineer** with general engineering experience and qualifications together with some electronic engineering experience.

Applications, giving details of experience, qualifications and age, quoting D.O.39, should be addressed to the

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THE salaries quoted are Australian currency.

WHERE permanent appointment is accepted, the successful applicant will be required to contribute to the Commonwealth Superannuation Scheme.

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Department of Supply,
Australia House,
Strand,
London, W.C.2.

with whom applications should be lodged by 30th June, 1955. [3826

PRINCIPAL Scientific Officer (minimum age 31) required by Ministry of Supply, Experimental Establishment near Salisbury, Wilts., to take charge of test work on engineering assessment of helicopters, Airborne Forces paratrooping and supplies dropping, aerial targets, etc. 1st or 2nd class honours degree or equivalent qualification in Engineering or Physics. A general knowledge of aeronautical engineering required and experience in experimental test work desirable. A house can be made available if desired. Salary within range £1,125-£1,507 (superannuable). Women somewhat less. Application forms from M.L.N.S., Technical and Scientific Register (K), 26 King Street, London, S.W.1, quoting C348/5A [3838

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The engagement of persons answering these advertisements must be made through the local office of the Ministry of Labour and National Service, etc., if the applicant is a man aged 18-64 or a woman aged 18-59 inclusive, unless he or she or the employer is excepted from the provisions of The Notification of Vacancies Order 1952.

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PLEASE apply giving full details of career and salary required (which will be treated in strict confidence) to: Personnel Officer, Louis Newmark, Ltd., Prefect Works, Purley Way, Croydon, Surrey. [3833

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WRITE full details experience to: Airport Manager, Lydd Airport, Kent. [3822

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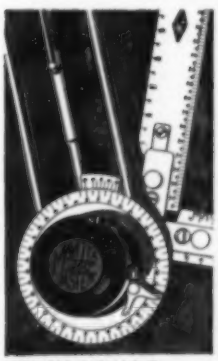

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AP264/133

AIR TROOPING

THE PATTERN OF DEFENCE now being shaped by the western powers has as one of its essential elements the speedy movement of troops by air to trouble spots and strategic outposts. For Great Britain, in particular, the need to move reinforcements quickly—perhaps a battalion at a time—to such widely scattered places as Malta, Gibraltar, Bermuda, the Caribbean, West Africa, Cyprus, Aden, Singapore, Hong Kong and elsewhere has made the use of aircraft obligatory. Air trooping has been steadily increasing the part it plays in such movement and is the method now used for nearly 50 per cent of the total Army trooping to and from theatres other than Germany.

The speed of the trooping aircraft, as against travel by sea, is self-evident. Sea transport moreover has the disadvantage that in carrying a much larger number of men per unit it is keeping them inactive in the "pipeline" for a comparatively long period. In effect this delay means that an increased number of men must be kept ready under arms; whereas by air, troops need not be out of action in transit for more than about twenty-four hours. By the proper use of the air, therefore, fewer men are needed to guard the widely dispersed outpost defences of the democracies. The manpower saving on the Far East route alone is estimated by the War Office to be one-seventh, so that out of every 10,000 moved in a year, there are 1,400 or 1,500 more men effective in the field.

Another feature of air trooping which has directly influenced the three Service Departments in their decision to expand its volume, is the net saving of air travel over most sea routes. From the United Kingdom to Egypt, for instance, in 1952/3 the average fare per head by sea was officially stated to have been £30, compared with £22 using charter aircraft. This is considerably less than even tourist fares on the scheduled airlines, since on troop charter work every available seat can be filled.

In 1950, the Government decided that the British independent operators should provide the bulk of the extra capacity needed to develop the air trooping scheme. In this way, a measure of stability would be given to these operators enabling them to invest in modern equipment and so provide an important strategic reserve of aircraft to supplement Transport Command when required.

The aircraft at present operated are mainly suited to the medium haul routes such as those to the Mediterranean, and there has been a shortage of large, long-distance airliners. The three Bristol Britannias recently ordered by the Government for trooping operations will be capable of doing the work of six of the smaller capacity machines now used.

The maintenance of British Commonwealth and Colonial communications has always taken into account the possibility of the hostile seizure of large areas normally open to air passage, and the denial of intermediate landing facilities calls for aircraft able to fly large loads rapidly and non-stop over long distances. This is the special characteristic of the Bristol Britannia. For example, in its Long Range version it would be able to fly from England to Singapore with one stop at Aden. Its trooping capacity on a shorter route is indicated by the fact that thirty 100-seat Britannias would be capable between them of moving 20,000 troops of Britain's future Home Strategic reserve to, say, the Middle East in a week.

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